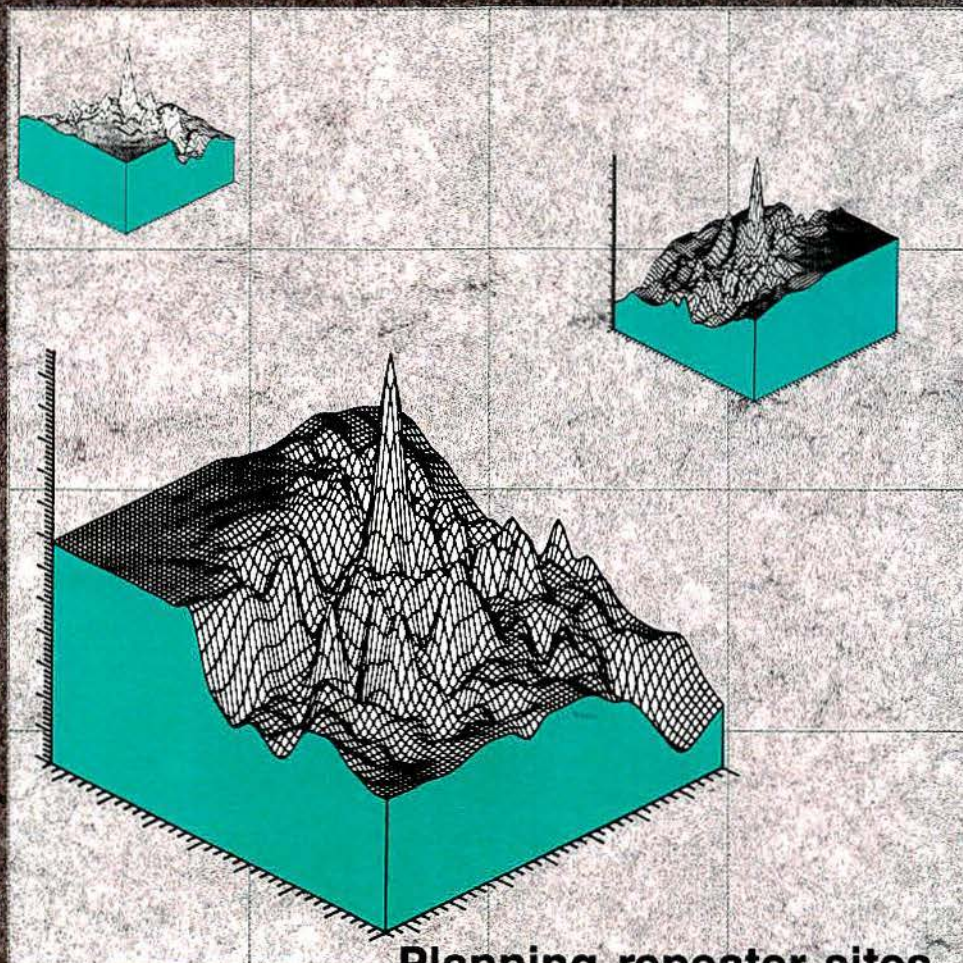


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The journal of mobile communications technology



Planning repeater sites, p. 10

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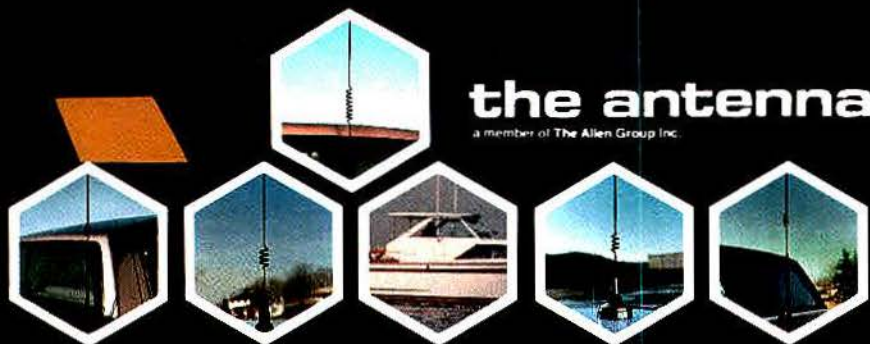
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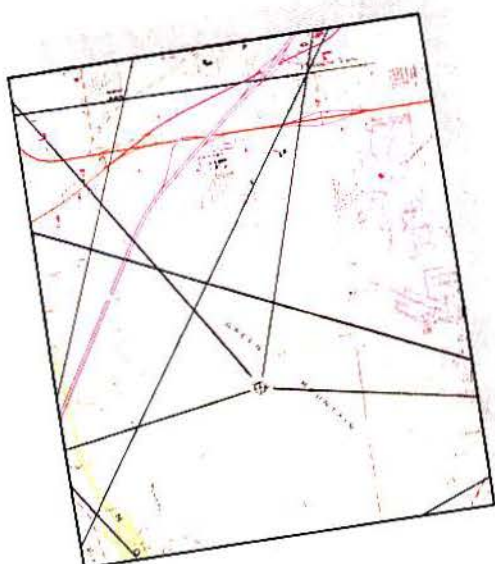
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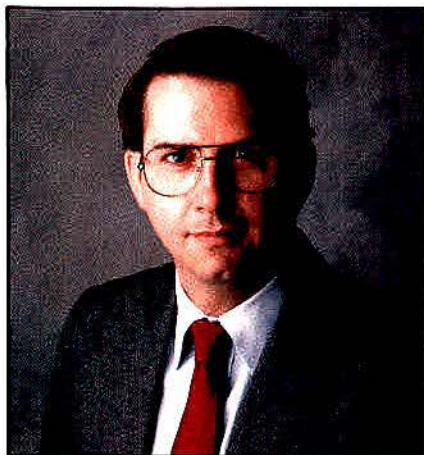
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The battle of La Mosca



A battle fought for a New Mexico mountaintop has been won by All-Comm, an Albuquerque two-way radio dealer. All-Comm vice president J.H. Ericksen led the company's defense of the high ground. The victory signals a better future for everyone who uses mobile radio communications relayed by repeaters at mountaintop antenna sites administered by the National Forest Service. (The Forest Service calls them "electronic sites.")

The adversaries were traditional—land mobile vs. broadcast.

The battleground, the La Mosca Peak Electronic Site in west central New Mexico, was established in the 1960s. Since then it has served exclusively as a land mobile radio and microwave antenna site.

The Forest Service approved the current La Mosca site management plan in 1988. It reflects efforts to improve electronic-site management on all federal land.

Opinions expressed by existing users helped mold the plan. Those opinions, together with documents showing the incompatibility between high-power and low-power users at other sites, led the Forest Service to continue limiting the site to low-power use. Foreseeing the possible approval of adjacent sites, the federal agency stipulated minimum separations of 1 horizontal mile and 500 vertical feet between La Mosca and any high-power transmitters.

FM station

But prior to the plan's approval, a broadcaster, Kapdin Communications,

asked permission to place a high-power FM broadcast transmitter at La Mosca. After the plan was approved, the request was denied.

Thus began the appeal process!

The broadcaster argued that:

- Harmful interference would not occur.
- The Forest Service had no evidence that it would.
- Making decisions based on interference matters rests with the FCC, not the Forest Service.
- The Forest Service has no right to enforce technical requirements at electronic sites.

The two-way radio dealer argued that:

- Co-located, high-power broadcast transmitters create broadband, on-channel transmitter noise exceeding the signal level that weak land mobile signals from hand-held transceivers typically deliver to repeaters.
- High-power broadcast transmitters multiply intermodulation interference problems enormously.
- Massive, tall broadcast towers affect microwave paths.
- Shorter broadcast towers render no vertical separation with land mobile antennas and deliver strong RF fields that may create a health hazard at ground level.

The appeal record numbers more than 1,000 pages. It includes a study from a Houston-based independent consultant, Shaffer & Associates, the Forest Service hired to sort the technical issues. The study supports All-Comm's contention.

The broadcaster carried the appeal to two levels, then bowed out.

The victory's importance

Why is All-Comm's victory important? Ericksen explains:

"The co-location of broadcast with two-way operations has historically led to major problems, all of them for the two-way user. The broadcaster has little incentive to remedy those problems, which may be beyond fixing, anyway.

"In the case of federal land, allowing one broadcaster onto a site opens the door for any and all, with the potential of reducing the site to uselessness. Much time and effort, including articles

in *MRT*, have been expended in an attempt to educate and help the Forest Service and the Bureau of Land Management in managing mountaintop sites in a manner that avoids interference problems.

"The results of those efforts finally are showing themselves in the newest Forest Service plans and in site management handbooks under preparation by both agencies." (Ericksen provided some of the information used in the Forest Service handbook.)

"Our victory in this challenge to the new plans has set a precedent that applies to the entire western United States. Existing two-way radio sites will be protected and, in the future, separate high-power and low-power sites will be established. The separation will benefit both the two-way radio and the broadcast communities."

We congratulate All-Comm and Ericksen on a nearly single-handed victory that is sure to have a resounding effect on two-way radio communications.

—Don Bishop

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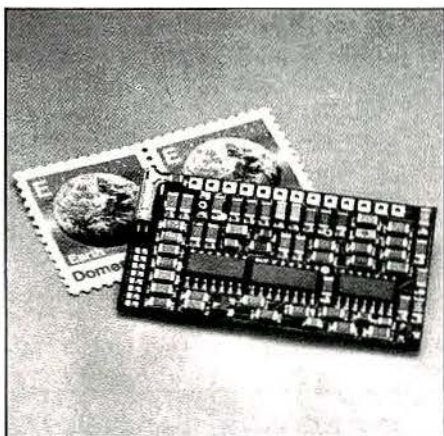
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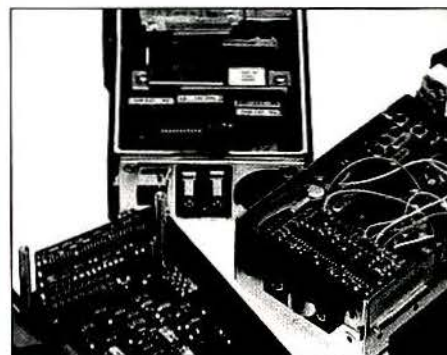
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Mobile installation:

"How to Install a Mobile Radio," an article by Roald Steen in the November 1988 issue, prompts me to submit some alternative opinions about installation techniques.

It is a fact of life that installers generally are not technicians, and they generally are not as highly paid as technicians. There may be schools for installers, but I have never heard of one. Therefore, when information is published on the subject, it is all the more important that it be as good as can be had.

- **Antenna placement**—I take issue with the use of a Greenlee punch and placing the antennas on the rear deck.

The Greenlee punch is a two-piece die. Using it to cut a hole in the roof requires the headliner to be dropped or removed for access.

A better tool for the purpose is a hole saw that removes paint, too, for a good ground.

Although the article states: "...much of the signal energy pattern from a roof-mounted antenna would be obstructed by the light bar, so the deck is a good compromise placement," the deck really is an unfavorable position for the antenna compared to the roof, despite interference from any light bar.

The amount of pattern distortion depends on many factors, such as the frequency, the type of antenna used and its distance from the light bar. As a rule of thumb, a poorly positioned rooftop antenna is less directional than a well positioned trunk deck antenna, assuming an identical VSWR.

- **Installing coax**—The article reads, "...do not use crimp connectors..." On the contrary, my installation specifications require coaxial cable to be terminated by crimp connectors. An installer must get specific authority from the engineering department to use hand-fitted coax connectors.

Installers are not highly skilled. They

often are pressed for time. With hand-fitted connectors, these combined disadvantages often result in poorly installed coax fittings, poor VSWR and other problems that may take several service calls to correct. Thus, the preferred coax termination is a uniform connector attached faster and better than connectors installed by hand, and for less money—the crimp connector.

- **Low-resistance connections**—Soldering irons nearly have become extinct since really good crimp joints have been available.

- **Dressing cable**—In the article, installers are instructed to make the wiring tidy with plastic tie wraps, then test the installation. But it is better to test the installation *before* tying down all the wiring. This way, if a mistake has been made, it is not necessary to cut the ties to correct the problem. Once the cable is dressed, the radio should be retested to be sure the dressing process did not damage the installation.

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The journal of mobile communications technology

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Letters to the editor

• **Proof of performance**—In addition to the tests prescribed in the article, the unit should be tested on the air. Make sure it is modulating properly and that it is free of hum or noise *with* the engine running.

Measure the forward *and* reflected power, and write the readings on the work ticket.

The installer is not expected to calculate VSWR. But the installer should know by rule of thumb that, if there is more than 10% reflected power, there could be a problem.

Articles of the nature of "How to Install a Mobile Radio," although mundane, are not printed often enough. Perhaps the topic is too complicated to cover in as much depth as can be done in an article as short as this one was.

L.E. Lindstrom
Radio Systems Engineer
Los Angeles Unified School District
Los Angeles

Mr. Steen's reply:

We can hope that radio installers develop habits and techniques that result in successful installations. Articles may offer ideas that can be useful, although opinions about specific procedures may differ. Here are some responses to points raised by Mr. Lindstrom:

• **Antenna placement**—It is correct that part of the headliner has to be disassembled to use the Greenlee punch. But the headliner ought to be partially disassembled for most roof-mounted antenna installations, whether a hole saw or a Greenlee punch is used. Failure to do so may result in a sloppy looking installation.

The best mounting place for the antenna is on the roof. The light bar influences the antenna emission pattern. The influence is greatest for shorter antennas, such as 450MHz quarterwave whips and 800MHz antennas.

When several antennas are mounted on the roof, each affects the emission pattern of the others. Together with the

light bar, the proximity of the antennas to each other may generate unexpected directivity. Nevertheless, the interaction is not so serious that it unduly influences antenna system efficiency.

The deck by the luggage compartment often is used as an alternative mounting site. I do not recommend placing an antenna on the deck if it is possible to place it on the roof.

• **Installing coax**—If the correct ratcheting tools are used, it is possible that a crimped connection may turn out to be as strong mechanically as a soldered connection. A crimped connection may be completed quicker than a soldered one.

• **Low-resistance connections**—When an experienced technician sees a voltage drop caused when a cable passes a great deal of current, the tech first should inspect crimp connections on the cable. Perhaps the galvanic action caused by connectors and conductors made of dissimilar metals causes resistance to develop in the connection. It may be best to avoid using crimp connectors on cables carrying a great deal of current, such as transmitter power leads.

• **Dressing cable**—The performance test should come last, following the final positioning and dressing of the wires and cables.

In most installations, the performance test only confirms that the installer has done the job correctly. If a problem is found that requires the release of a tied cable, it is a simple procedure to cut the plastic tie wrap to correct the problem. Once the problem has been corrected, the installation should be retested to verify the corrective action worked.

• **Proof of performance**—It is advisable to have a technician supervise or at least advise the installer during the installation procedure.

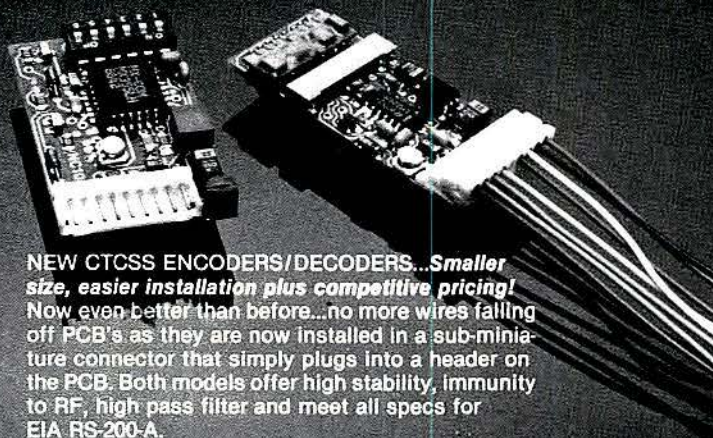
Perhaps the technician, rather than the installer, should test the installation and initial the log to confirm the installation completion and inspection.

Entering forward and reflected power measurements into the log is fine. Other information may be included, such as receiver sensitivity and transmitter deviation. But many prefer to make a simple log entry when the installation is finished.

Roald Steen
Woodbury, MN



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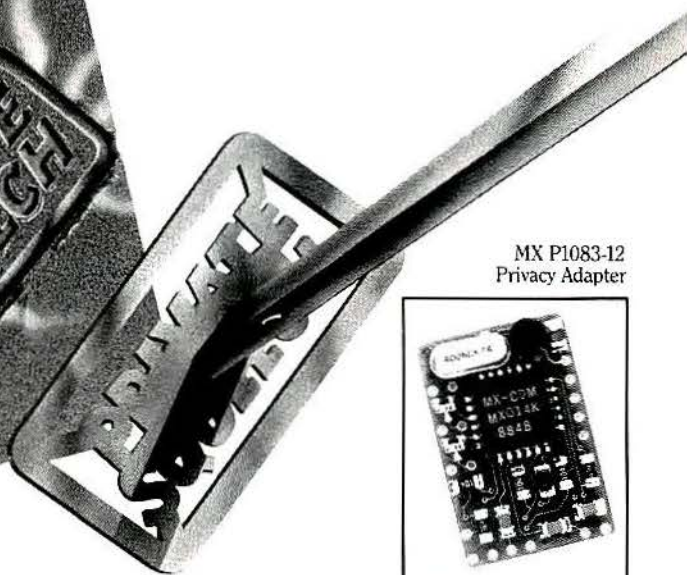


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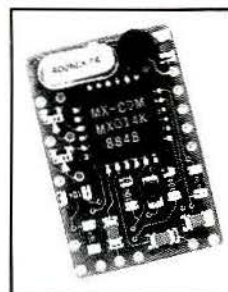
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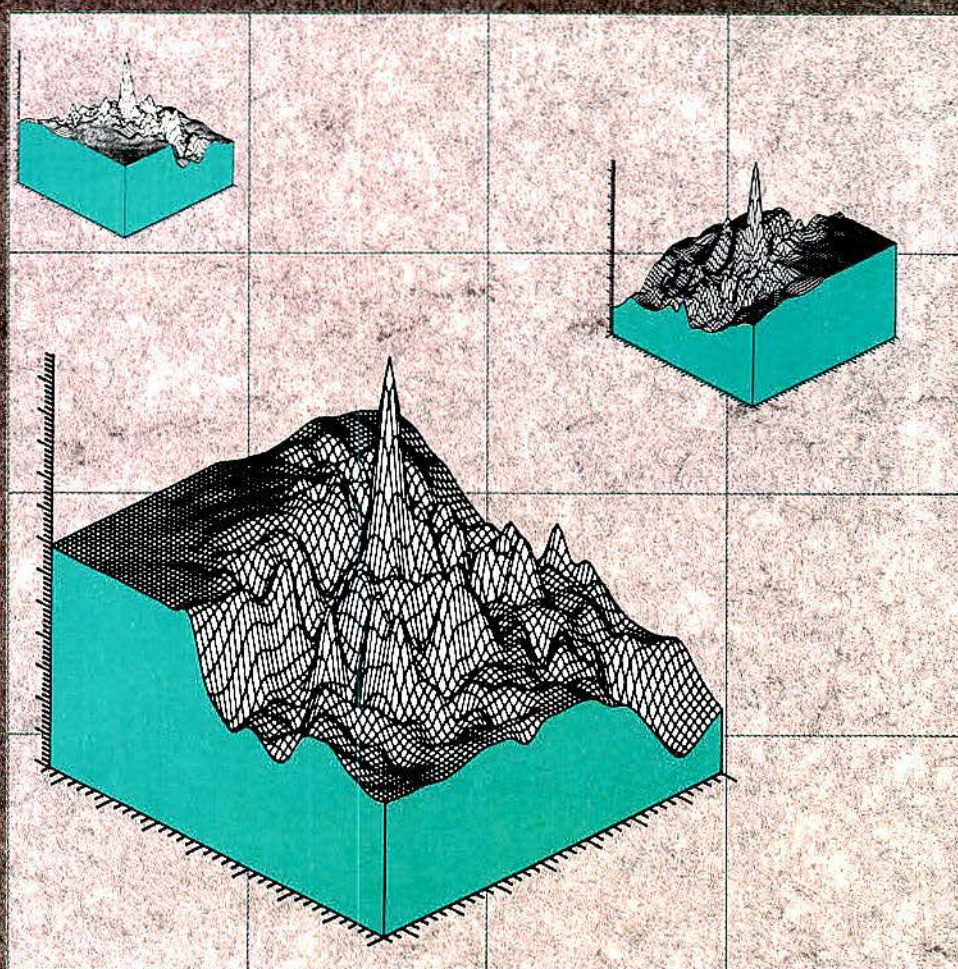
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Use digitized terrain data to plan a repeater site

Software that calculates path profiles and Fresnel zone attenuation gives radio communication system designers enormous flexibility to evaluate prospective sites and plan facilities that deliver the desired coverage.

By Michael Wiebe, P.E.,
and Larry D. Ellis, P.E.

Once upon a time there was a land where all the repeater sites were on high, high mountaintops, and they all had line-of-sight views to everywhere. No customers ever complained, and all the engineers lived happily ever after.

Unfortunately, repeaters are not located in such a fantasyland. Instead, they are installed in a real world with terrain obstructions, shadowing losses and path attenuation.

Zoning and environmental restrictions often limit tower heights. Leasing costs for the best sites may be prohibitive. Rugged terrain may punch unacceptable "holes" in the desired coverage area.

To overcome these obstacles, steps to plan a successful installation must begin long before applications are filed with the FCC and long before the first piece of coaxial cable is installed.

Site selection

Selecting the right site is critical to any installation—especially for repeaters. An obstruction between a repeater and a mobile unit that causes poor reception is perceived as poor reception between that unit and *all other units*, including mobiles and base stations.

The degraded reception makes it appear as though poor service is being delivered to the entire coverage area, a

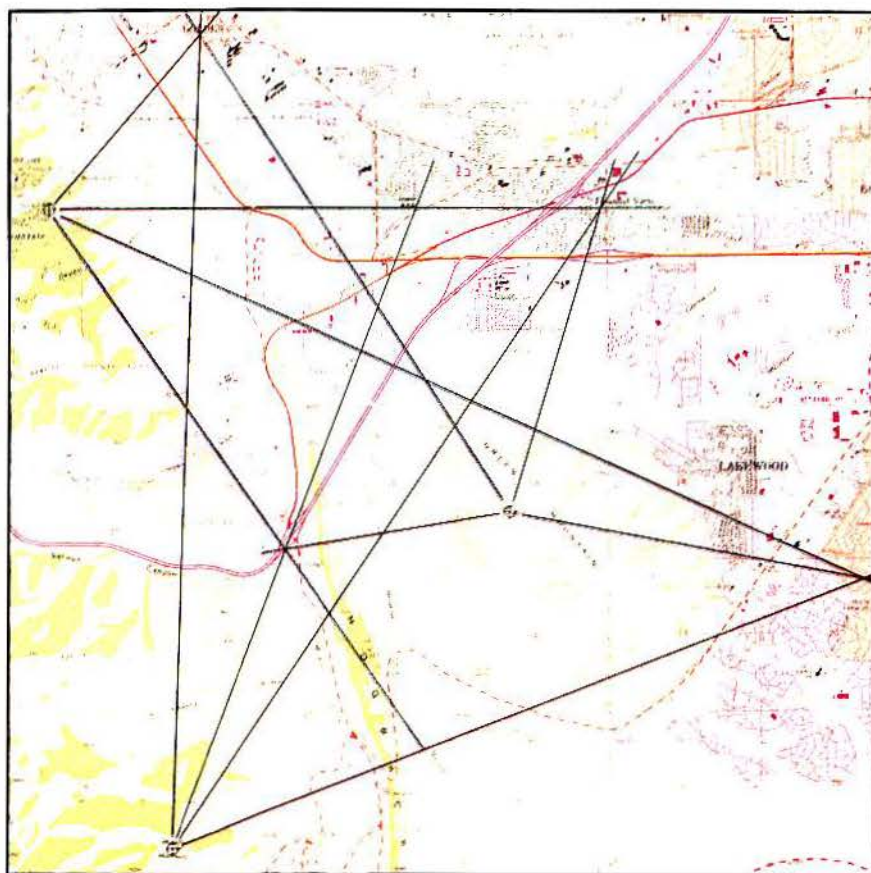


Figure 1. Three potential sites intended to cover four target areas. The confusion of criss-crossing paths only *begins* to communicate the amount of work required to obtain a defensible evaluation of each site.

situation that is sure to generate customer complaints.

Each site under consideration as a potential repeater location may be evaluated initially with certain questions:

(1) Will terrain shadowing or grazing losses degrade the coverage of any target area?

(2) If two or three possible sites are available, which will serve intended users the best?

(3) What is the purchase or leasing cost for the site?

(4) How tall must the tower be to provide the desired coverage from this site? How much will the tower cost?

Answering these questions is a lot of

Wiebe and Ellis, practicing telecommunications engineers for 15 years, developed Terrain Analysis Package (TAP) software to model radio propagation. They own SoftWright, Aurora, CO.

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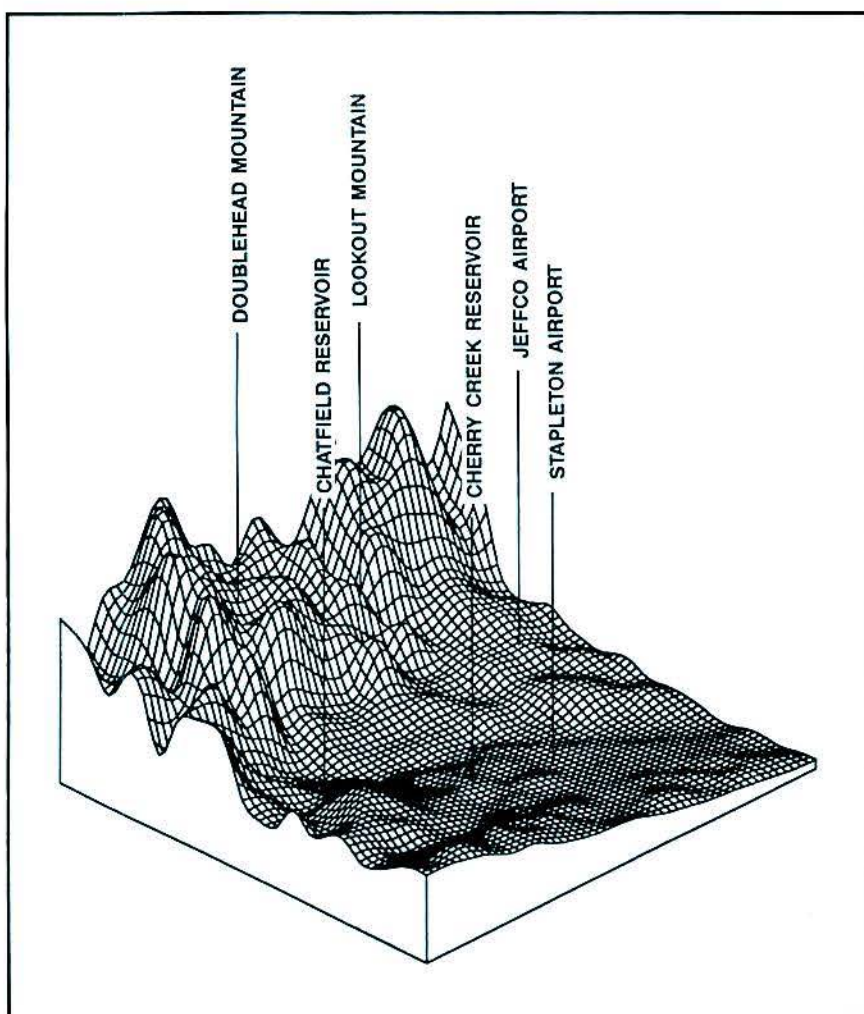


Figure 2. A three-dimensional view plotted with the use of the digitized terrain database supplements an initial examination of topographic maps in the site selection process. The view helps you to visualize the general terrain and potential repeater sites from different views.

work. If several potential sites are under consideration, the magnitude of the task can be overwhelming. Collecting path elevation data, checking for terrain obstructions, computing Fresnel zone clearances and quantifying path grazing for dozens of radials for each site can wear down the most persistent engineer. But without thorough work, decisions may be based on unwarranted conclusions or judgments.

Available locations must be compared carefully to determine which site would provide adequate coverage for the lowest cost. Spotty or inadequate coverage results in customer complaints and, ultimately, no customers at all. On the other hand, an exorbitantly expensive facility, overdesigned through a lack of thorough terrain and coverage analysis,

may doom a new service to economic failure before it can pay for itself.

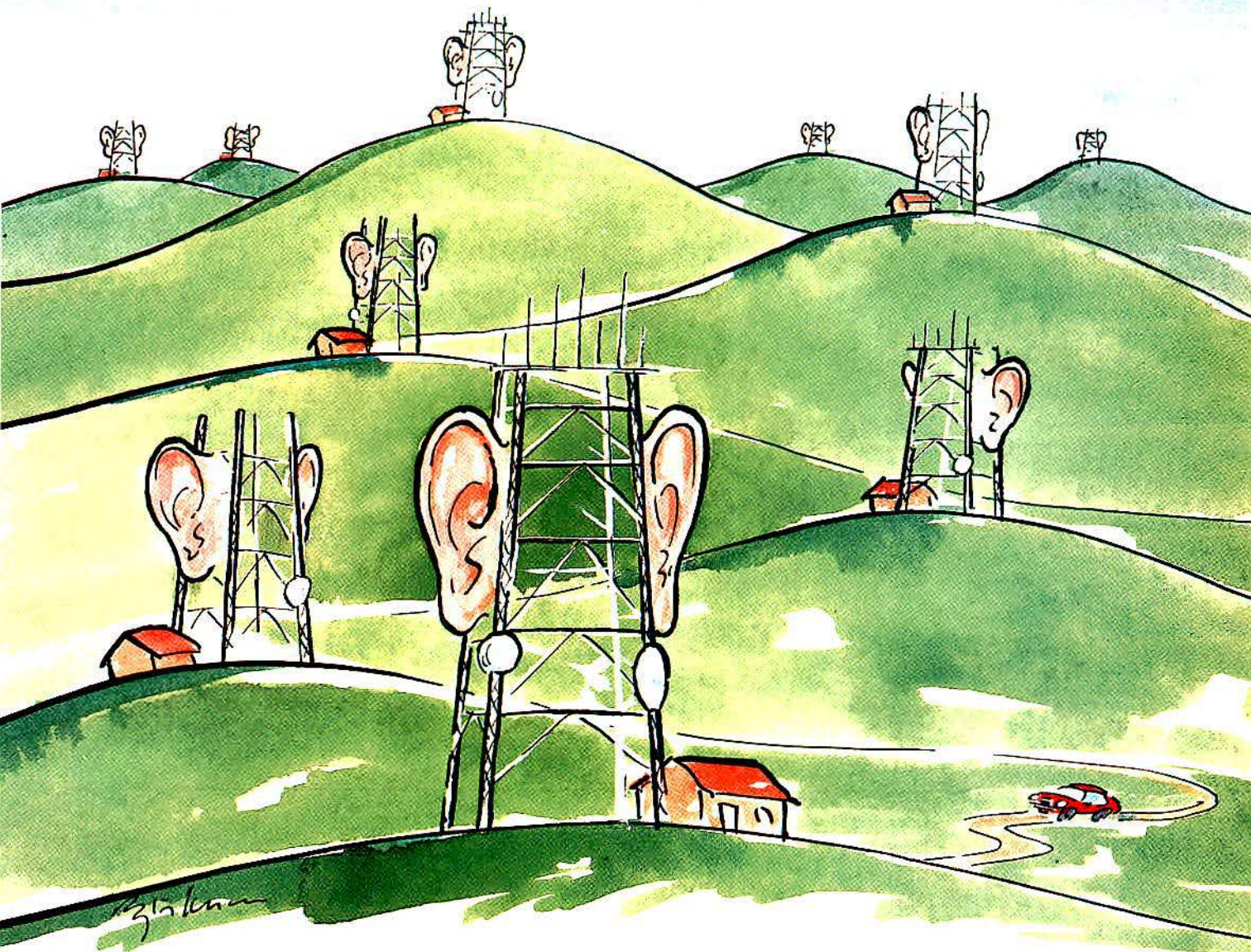
Site example

Figure 1 on page 11 illustrates a trivial example of three potential sites intended to cover four target areas. The confusion of criss-crossing paths only begins to communicate the amount of work required to obtain a defensible evaluation of each site.

Potential sites must be evaluated carefully for comparable coverage. All costs must be considered.

For example, a site with a less expensive annual lease may require a taller tower or a more sophisticated antenna design to deliver coverage essentially equivalent to that provided by a more expensive site.

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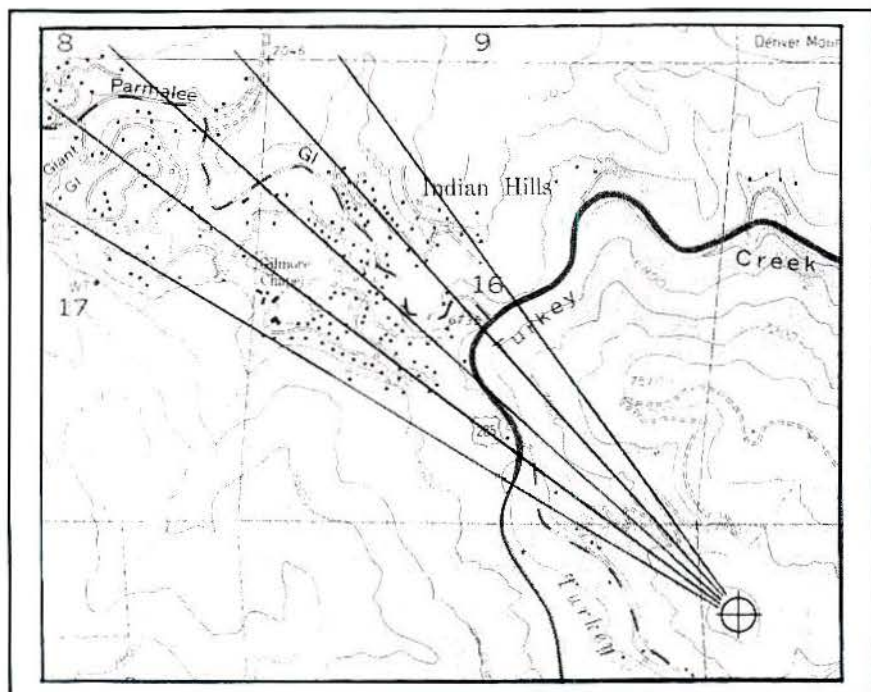


Figure 3. Because terrain elevations may differ widely, radials for a target area generally should be no more than 5° to 7° apart, depending upon the topography. If

the intervening terrain is especially rugged, the radials should be much closer together. The diagram above shows five sample radials.

coverage can be made only after extensive path and shadowing studies have been made for each site. Generally, two sites never provide the same coverage, even if tall towers are used to reduce coverage differences caused by terrain variations. Careful study provides an objective comparison of various sites to reveal the advantages and disadvantages of each location.

Guessing is too risky.

If dead spots are found after construction is complete, reputations and goodwill may suffer. The "seat-of-the-pants" approach—"Let's add 75 feet more to the tower, just to be safe"—may deliver a system that works, but at a cost that may be thousands of dollars more than necessary. The goal is to build a system that works well *and* is reasonably affordable.

The digital approach

A traditional way of evaluating a site involves examining topographical maps of the area to compare site elevations, any terrain obstructions and the desired

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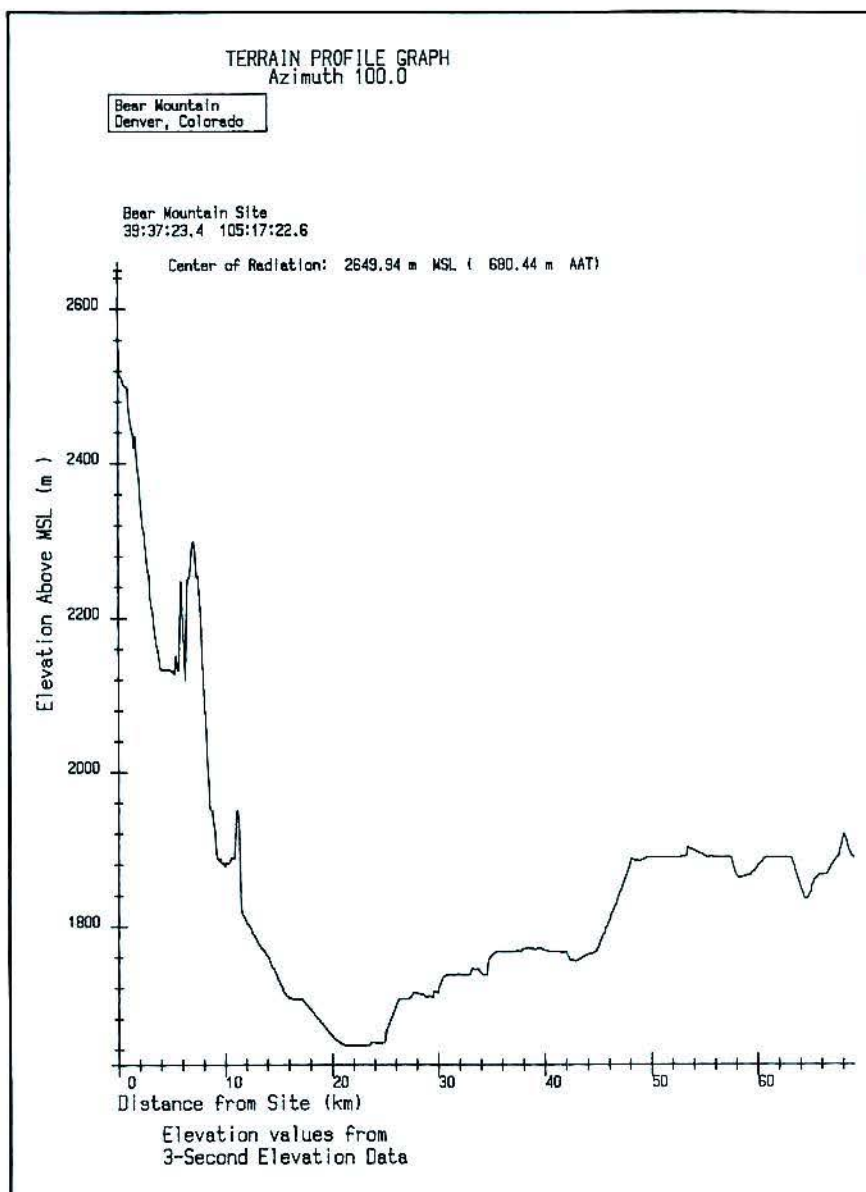


Figure 4. Compare this profile plot of a path without earth curvature correction, a so-called 'flat-earth' plot, with the profile plot in Figure 5.

coverage area. It can be a tedious, eye-fatiguing and error-prone task to read thousands of elevation figures.

Digitized terrain databases replace the hand-and-eye work with a few minutes of computer operation. The monotonous calculation of Fresnel zone values and clearance ratios and the interpolation of curves to determine shadow or grazing losses is accomplished in seconds, painlessly.

With software tools, the engineer's time and talents can be focused on evaluating and interpreting critical data instead of spending hour upon hour, squinting at minuscule map markings

and tabulating elevation data.

Evaluating and comparing many potential sites becomes a manageable task, whether three radials or 50 radials are involved for each site. Numerical and graphical analysis of each path enable the engineer to compare sites and determine facilities required at each site to achieve the desired coverage.

Even if only one site is being considered, an exhaustive study must be performed to ensure the optimum design combination of tower height, antenna design and transmitter power.

Although dial-up, on-line, pay-per-minute services provide certain

topographic data, high-resolution databases are available for personal computers to allow each user to have and to manipulate the data in-house. When database systems are available in-house, multiple studies can be performed as necessary. Optimum site selection and facility design can be accomplished without continually watching the clock and mentally calculating long-distance and connection charges.

Using the database

Here is an example of how a digitized database may be used advantageously in evaluating a site:

- *Select potential sites*—If an area includes developed communications sites,

Initial selection of potential sites, especially in an unfamiliar area, often is easier with a three-dimensional plot.

they should be considered. But undeveloped sites may warrant consideration too, especially if developed sites are heavily congested.

Use the digitized terrain database to supplement an initial examination of topographic maps in the site selection process. Plot a three-dimensional view of the area, as shown in Figure 2 on page 12. The three-dimensional view helps you to visualize the general terrain and potential repeater sites from different views.

Initial selection of potential sites, especially in an unfamiliar area, often is easier with a three-dimensional plot than it would be by trying to visualize contours from a topographic map.

- *Define coverage areas*—The typical goal of "covering the world" from a given site is too general to be useful in site evaluations.

Pick the most critical areas, such as

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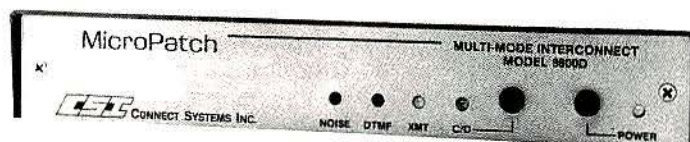
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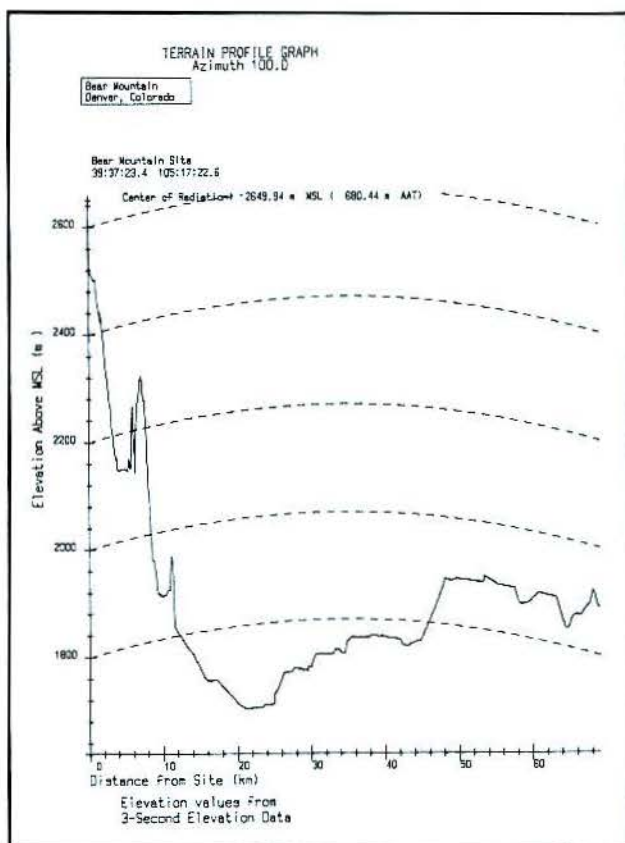


Figure 5. This profile plot includes the 4/3 earth curvature correction to illustrate its importance of the correction. Naturally, the effect of the earth's curvature becomes more pronounced for longer paths.

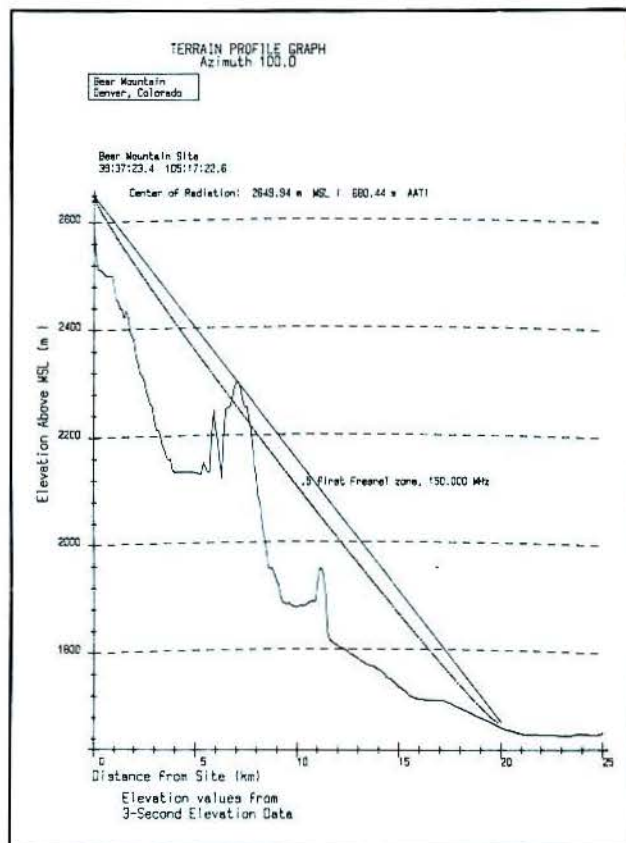


Figure 6. Taking the profile plot a step further, the diagram shown above includes a line-of-sight path and a Fresnel zone, factors to be considered in calculating path losses to target areas.

a business district, a length of highway and specific suburbs. Include areas known or suspected to be difficult to cover from the site under consideration.

If other repeaters operate in the community, identify areas known to have poor reception from their sites. Detailed path studies will concentrate on these areas.

• **Select radials through the community**—Select several representative radials to use in examining each mobile service area.

Because terrain elevations may differ widely, radials for a target area should generally be no more than 5° to 7° apart, depending upon topography. If the intervening terrain is especially rugged, the radials should be much closer together. Figure 3 on page 11 shows five sample radials.

Once again, the terrain database helps with visualizing target areas and isolating areas of particular interest. Use the three-dimensional surface representation to reveal potential problems im-

mediately, problems such as intervening terrain obstructions that may not be obvious from an examination of topographic map contours.

• **Plot radial profiles**—Extract elevation values from the digitized database. Read the extracted data values and compare the peak values to values on the topographic map.

No database is perfect, so it is advisable to correct peak elevation values in extracted data manually. For critical paths, exact map elevations may be substituted for the interpolated values from the database. This extra precaution ensures the best possible accuracy from the map data. The "peak correction" process absolutely is required when you use a database with elevation data resolution of 30 seconds because the elevation points from the database are approximately a half-mile apart.

Manual correction is less critical with a three-second database because elevation points are only 200 feet to 300 feet apart.

Moreover, it is important to correct elevation data manually to account for other obstructions such as trees and man-made structures.

Plot radial elevations vs. distance, correcting for earth curvature. Typically, the earth curvature correction is based on 4/3 of the earth's radius to compensate for atmospheric bending of radio waves.

Elevation values are corrected for earth curvature based on the formula:

$$E_{corr} = E + (78.5/k) \times 10^{-9} \times D(P-D)$$

where

E_{corr} is the corrected elevation to be plotted.

E is the elevation in meters.

k is the earth curvature factor (typically 4/3).

D is the distance from the transmit-

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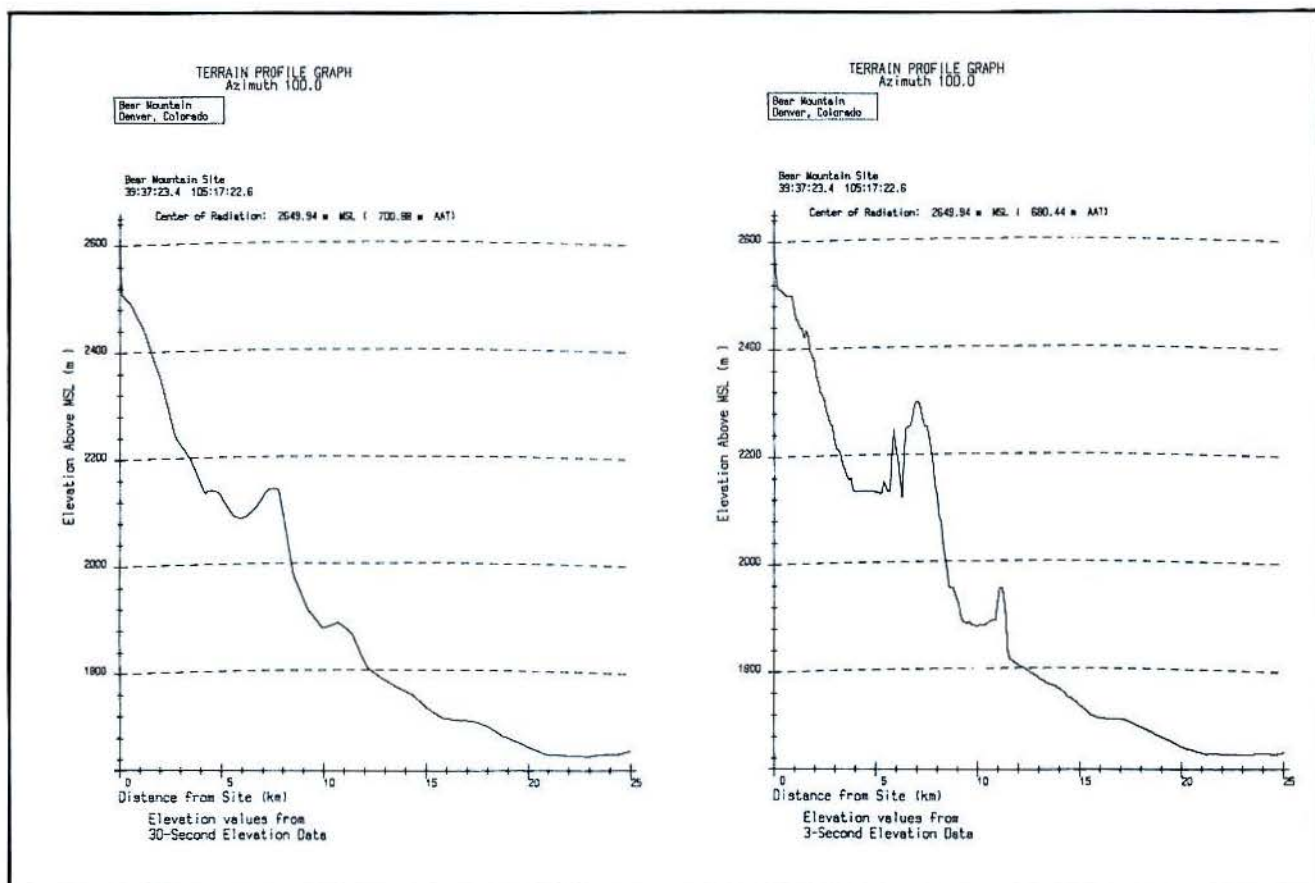


Figure 7. This diagram shows the same radial plotted from a 30-second database and a three-second database. It shows the importance of using three-second data for detailed path studies because the apparent unobstructed line-of-sight path indicated by the 30-second data is erroneous. The obstructions are shown clearly by the higher-resolution three-second data.

ter site to the point (in kilometers).

P is the distance from the transmitter site to the end of the path (in kilometers).

Figure 4 on page 16 shows a profile plot of a path without earth curvature correction, a so-called "flat-earth" plot.

A comparison of Figure 4 with Figure 5 on page 18, which includes the 4/3 earth curvature correction, illustrates the importance of the correction. Naturally, the effect of the earth's curvature becomes more pronounced for longer paths.

After the path profile has been plotted, a straight line-of-sight plot can be added, along with a Fresnel zone for the specified frequency.

The Fresnel zone can be envisioned as a symmetrical envelope around the line-of-sight path. The "envelope" has its maximum diameter at the path midpoint and shrinks to zero at each end.

Because of the spreading energy from

the transmit antenna, any penetration of the space around the line-of-sight path defined by approximately 0.6 of the Fresnel zone results in signal attenuation.

The Fresnel zone distance is a function of frequency and the distance along the path. It is calculated with the formula:

$$\sqrt{\frac{W \times D_1 \times D_2}{D_1 + D_2}}$$

where

W is the wavelength of the operating frequency.

D_1 is the distance from the transmitter to the point under consideration.

D_2 is the distance from the point to the end of the path. Note that $D_1 + D_2$ are the total path length. All values of wavelength and distance must be ex-

pressed in the same units, e.g., feet or meters.

For each point on the path, clearance between the corrected database elevation and the straight-line path is computed. If the clearance is less than 0.6 of the computed first Fresnel zone, the ratio between the actual clearance and the Fresnel zone value is used to determine the signal attenuation (in decibels) resulting from the obstruction.

The ratio then is used to read a loss value from attenuation curves. This method is described by Kenneth Bullington in "Radio Propagation for Vehicular Communications," *IEEE Transactions on Vehicular Technology*, Vol. VT-26, No. 4, November 1977.

Figure 6 on page 18 shows the plotted path profile with the line-of-sight path and Fresnel zone added.

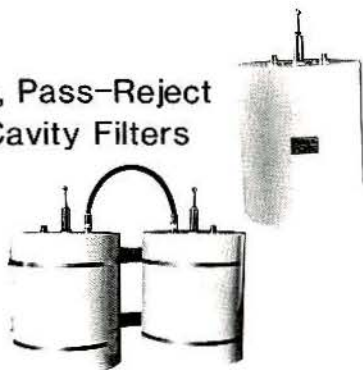
Database resolution

Digitized terrain databases are available in various resolutions. The databases are defined as a grid of

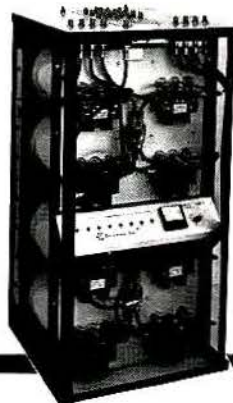
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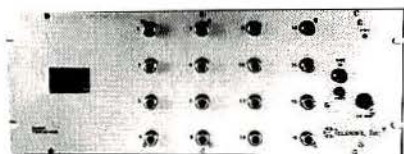
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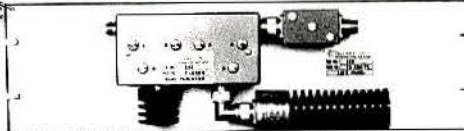
Transmitter Combining



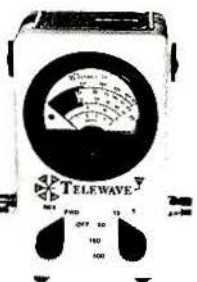
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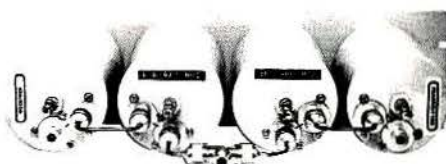
IM Suppression Panels



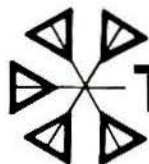
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TERRAIN PROFILE GRAPH
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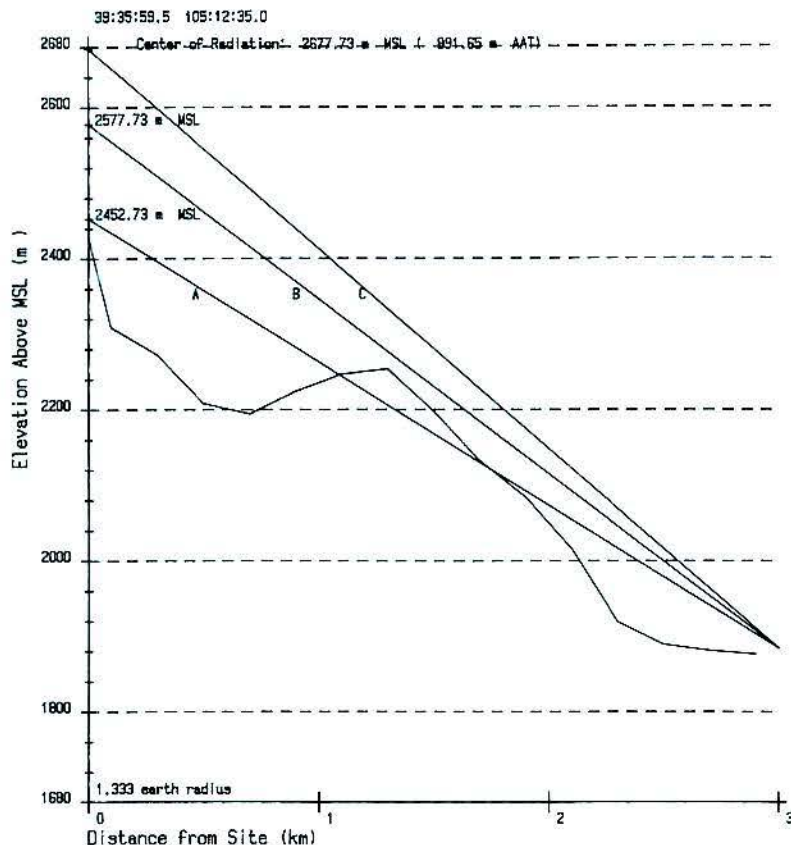


Figure 8. Paths to the same target area from the same site may be ineffective, adequate or overbuilt depending upon the tower height at the site. Path (A) ensures consequential obstruction losses. Path (C)

provides more clearance than necessary and at a substantially increased cost. Path (B) offers adequate clearance at a cost several thousand dollars less than the tallest tower.

latitude and longitude, with sample points every 30 seconds or three seconds, depending on the intended application.

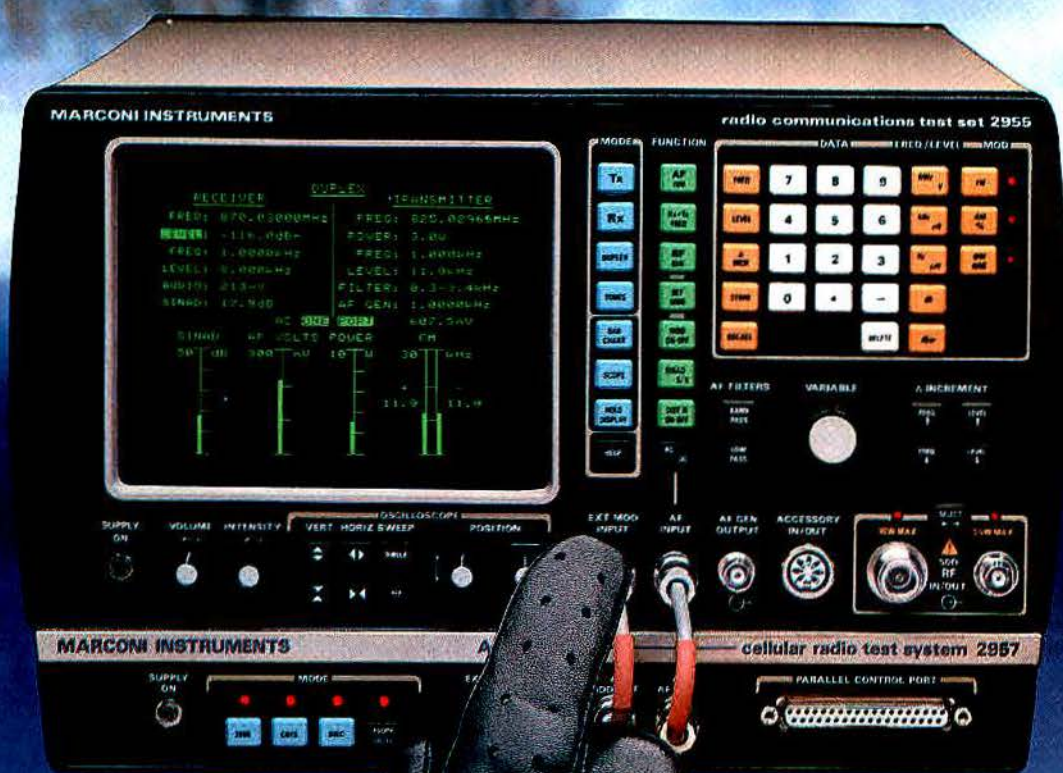
For example, Figure 7 on page 20 shows the same radial plotted from a 30-second database and a three-second database. This illustration shows the importance of using three-second data for detailed path studies because the apparent unobstructed line-of-sight path indicated by the 30-second data is erroneous. The obstructions are shown clearly by the higher-resolution three-second data.

The 30-second database is especially useful for data-averaging. Its use for this purpose has been approved by the FCC. Typical applications include height above average terrain calculations.

More realistic signal level predictions that include path losses on particular radials, including the Bullington method mentioned previously, benefit substantially from the increased resolution of three-second data.

The Bullington method is used by the National Oceanographic and Atmospheric Administration for protecting the "Quiet Zone" near Boulder, CO.

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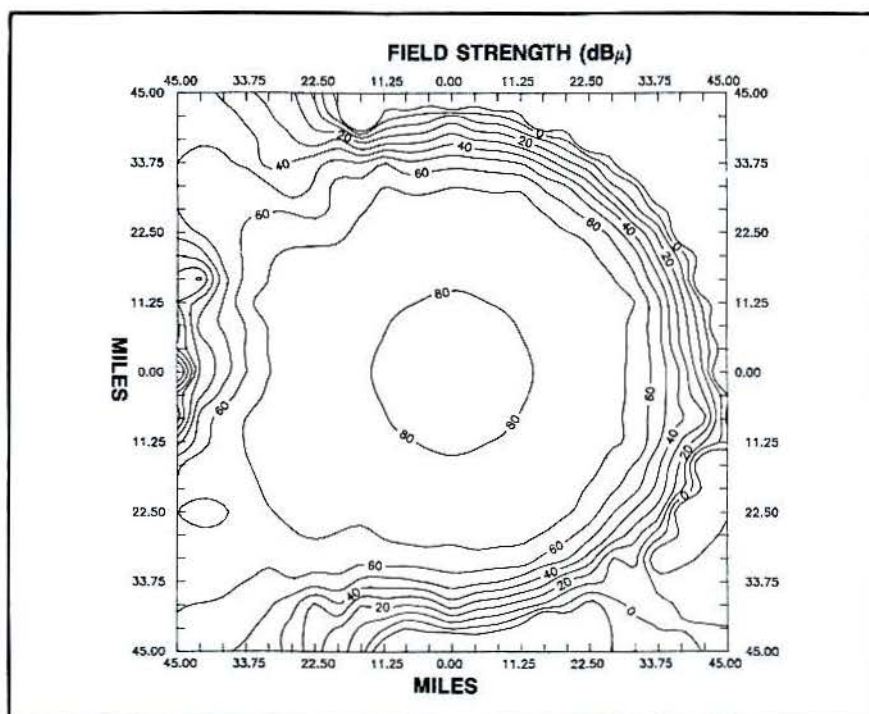


Figure 9. A 'shadow map' of computed field strengths, adjusted for terrain attenuation, shows lines of equal field strength. Areas of unusually low field strength are isolated for further investigation.

Measured fields correspond quite well with the Bullington predictions.

'What if...'

When the terrain plot is complete, including the Fresnel zone, the computed free-space field at the target area can be adjusted for calculated path losses.

Antenna tower height, effective radiated power, antenna design and other factors can be adjusted to obtain the most economical combination to produce the required field strength.

Using the terrain database and software to perform Fresnel zone and path loss calculations, the proposed facility elements can be adjusted and the resulting coverage can be computed many times to determine the optimum design. ("What if...")

Figure 8 on page 22 illustrates a path as it would be served by towers at three heights.

The shortest tower (path A) ensures consequential obstruction losses.

The tallest tower (path C) provides more clearance than necessary and at a



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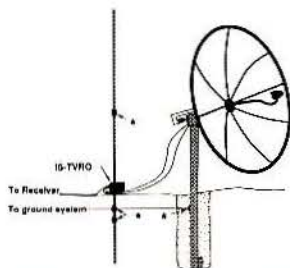
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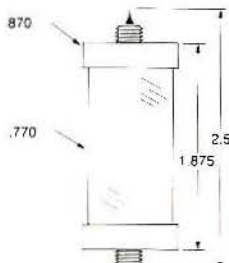
STRIKE COUNTERS
TOWER/POWER/PHONE



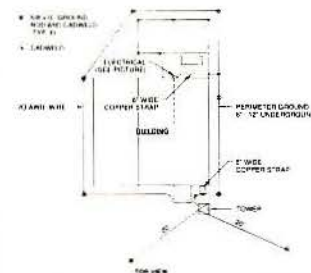
CHEMICAL
GROUND SYSTEMS



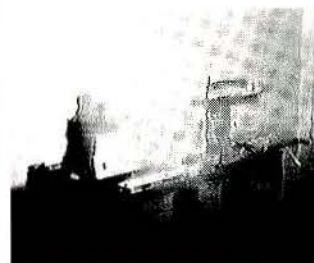
BREAKDOWN TESTERS



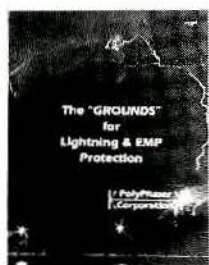
GAS TUBES
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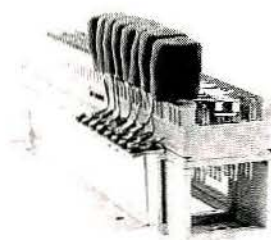
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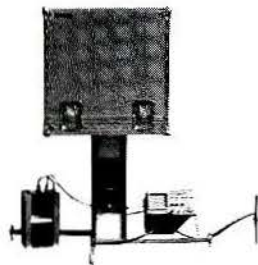
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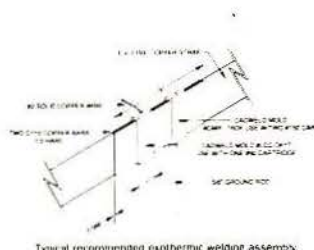
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substantially increased cost.

The middle tower (path B) offers adequate clearance at a cost several thousand dollars less than the tallest tower.

Note that Figure 8 shows only the line-of-sight paths. The Fresnel zone for each path is omitted for simplicity.

Even if no reasonable tower height provides an unobstructed path and complete Fresnel zone clearance, a similar

comparative approach can be used to determine the necessary tower height to achieve the desired received field.

Because the computed free-space field remains virtually unchanged, adjusting the tower height essentially changes only the Fresnel zone penetration and resulting obstruction attenuation. The tower height can be adjusted and the Fresnel zone and path loss

recalculated several times until an acceptable configuration is determined.

Comparing results

As numerous point-to-point studies are performed, the cumulative results can be combined to provide an overview of the predicted coverage. Using digitized terrain data and appropriate software automates the process. Quantities of information are generated that would be impractical to produce by manual methods.

For example, repeated path studies can be performed to compute path-

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*Computed field
strengths, adjusted for
terrain attenuation, can
be plotted to show lines
of equal field strength.*

attenuation and field-strength values to sample points every 0.5km from the site to a distance of 40km or 50km on 72 radials around a site (every 5°). The abundance of information then can be plotted to provide a clear, graphical representation of the predicted coverage in all directions from the site.

Computed field strengths, adjusted for terrain attenuation, can be plotted to show lines of equal field strength. Such a plot, commonly called a "shadow map," is shown in Figure 9 on page 24.

This type of map resembles a topographic elevation map. It consists of numerous closed contours. Areas of unusually low field strength are isolated for further investigation.

Three-dimensional plot

The most effective and illustrative presentation of the computed field strength data is a three-dimensional plot showing high and low fields. The enormous quantity of terrain elevation data required for this type of plot demands

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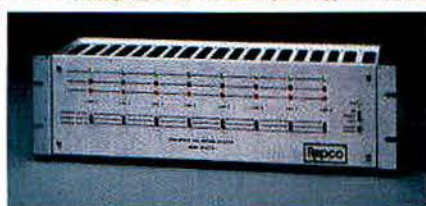


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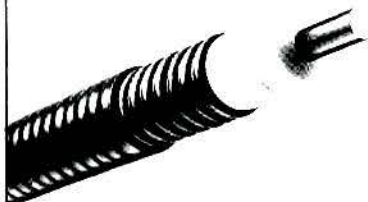
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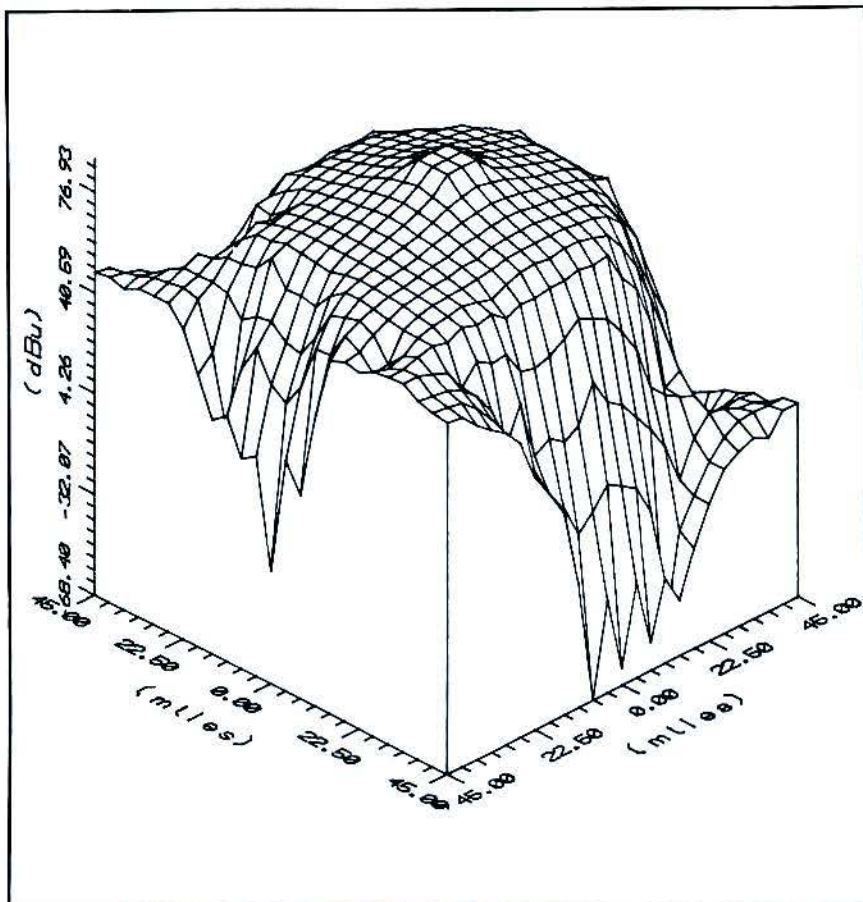


Figure 10. A three-dimensional plot of computed field strength around a site can be rotated and viewed from any azimuth or elevation, making it easy to note areas of reduced coverage—"holes" that may

need more study. This plot is most beneficial when elevation values are based on the higher-resolution, three-second database.

the use of a digitized database.

Figure 10 above shows a sample of a three-dimensional plot of computed field strength around a site. The plot in Figure 10 required approximately 7,200 elevation points for the field strength attenuation calculations, a number clearly beyond the scope of data extracted manually from maps.

The three-dimensional plot, which can be rotated and viewed from any azimuth or elevation, makes it easy to note areas of reduced coverage—"holes" that may need more study.

As discussed previously, this study is most beneficial when elevation values are based on the higher-resolution, three-second database.

The three-dimensional plot is a useful analytical tool for engineers. It is a valuable "visual aid" for use in presenting a facility proposal to management or investors.

Trying to explain field-strength values to a non-technical audience can be frustrating for everyone. A plot similar to the one shown in Figure 10 can communicate instantly the differences among sites. It can communicate the difference between "before and after" descriptions of proposed facility upgrades.

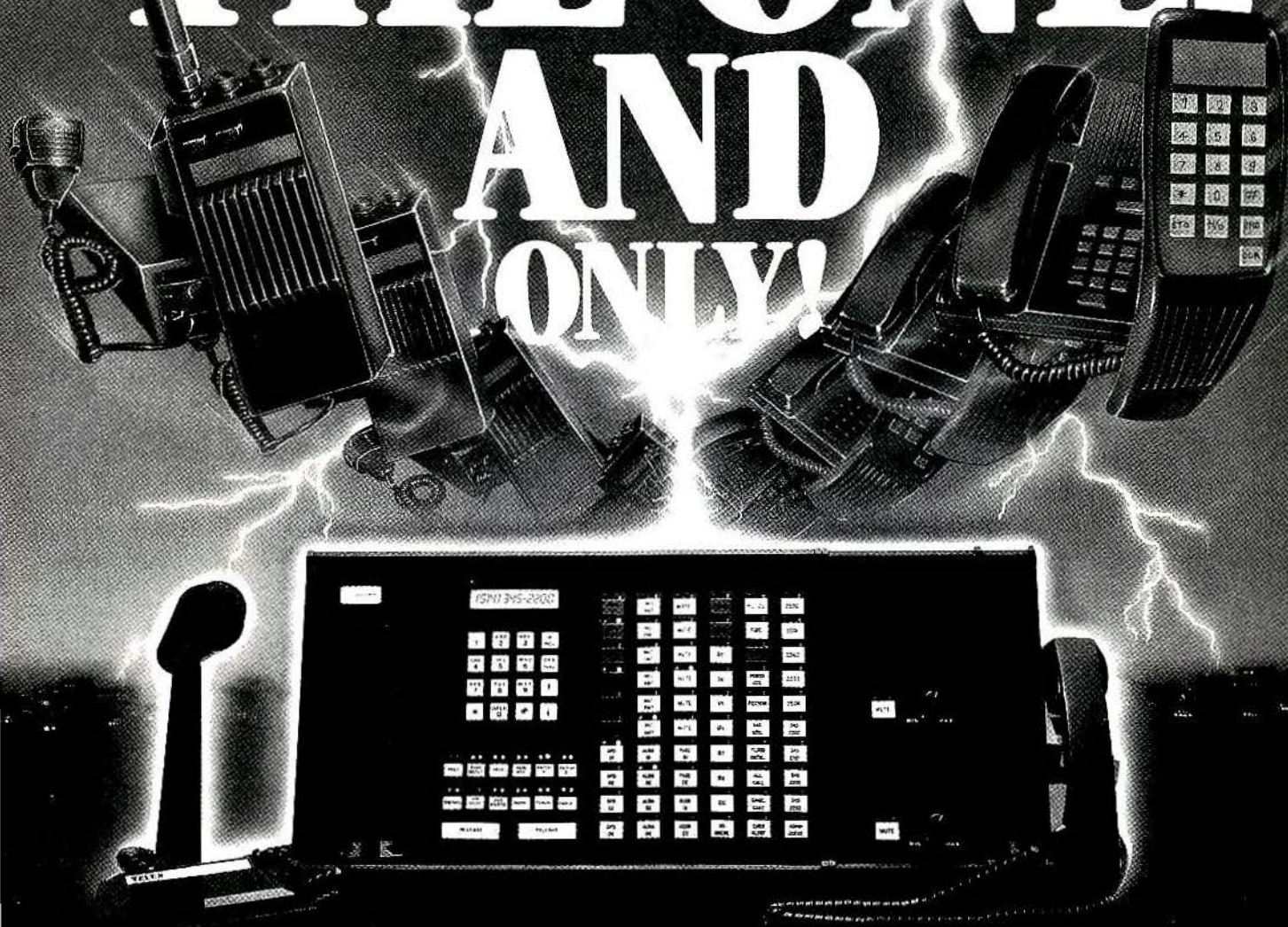
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Circle (26) on Fast Fact Card

Universal vehicular repeater extends portable range

Sophisticated logic and switching circuits control back-to-back transceivers that form a vehicular repeater. The repeater extends the range for reliable hand-held radio communications.

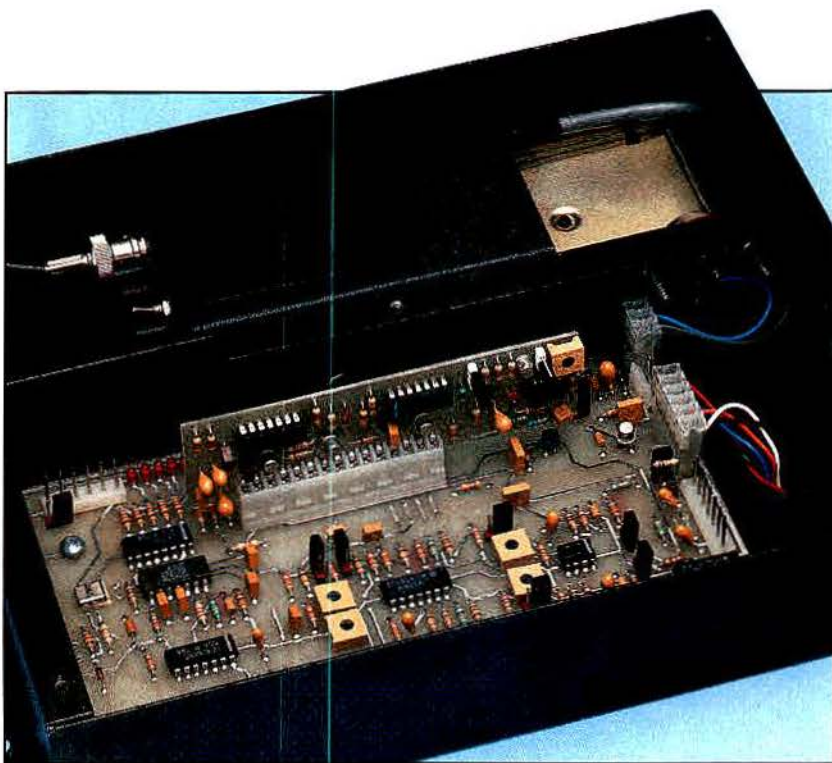
By Wes Sutton

"Out of the vehicle" does not necessarily have to mean "out of communication" such that mobile transceivers can reach the base station but hand-held transceivers normally cannot. From some areas, it may be impossible to reach the dispatcher with a portable because of its low power (usually 2W to 5W) and relatively inefficient loaded ("rubber duck") antenna. The answer is to use a repeater installed in the vehicle to re-broadcast the hand-held transceiver's signal to the dispatcher.

For a police officer, firefighter, ambulance driver, paramedic or other public safety specialist, hand-held radio communication may be vital to saving lives and protecting property. Hand-held transceivers provide instant communication in critical situations when a few minutes mean the difference between life and death.

'In-band' vs. 'crossband'

When vehicular repeaters operate in



A vehicular repeater with cover panel removed shows the internal transceiver and logic board. Another version connects with an optional, external transceiver.

the same frequency band as their companion mobiles ("in-band" operation), mutual interference, usually in the form of receiver desensitization, may limit the effective use of this mode. To reduce the interference potential, the vehicular repeater may be operated on a different frequency band than the one used by its companion mobile ("cross-band" operation).

Cross-band operation is by far the most popular mode of operation because of its reliability and ease of installation.

Several considerations include the following:

- (1) System operators who already

have a stock of portables and who want to add vehicular repeaters may be forced by budget requirements to use an in-band system.

(2) Some vehicular repeaters are capable of both in-band and crossband operation, making it possible to replace in-band portables with crossband portables as the in-band units are retired.

(3) When an entirely new system is being designed, exclusive use of crossband portables might be specified.

(4) A vehicular repeater that is compatible with most

brands and models of mobile units makes it possible to improve portable communication for public safety and commercial users who currently may use or who may add different kinds of equipment to their systems.


Desirable technical characteristics for a vehicular repeater include low-distortion audio and positive repeat switching, whether the switching is controlled by sub-audible tones or carrier sensing.

A vehicular repeater system includes a low-power transceiver. The flexibility of choosing the transceiver component to fit specific applications, such

Sutton is the product manager for radiolink systems at Magnum, Blaine, WA.

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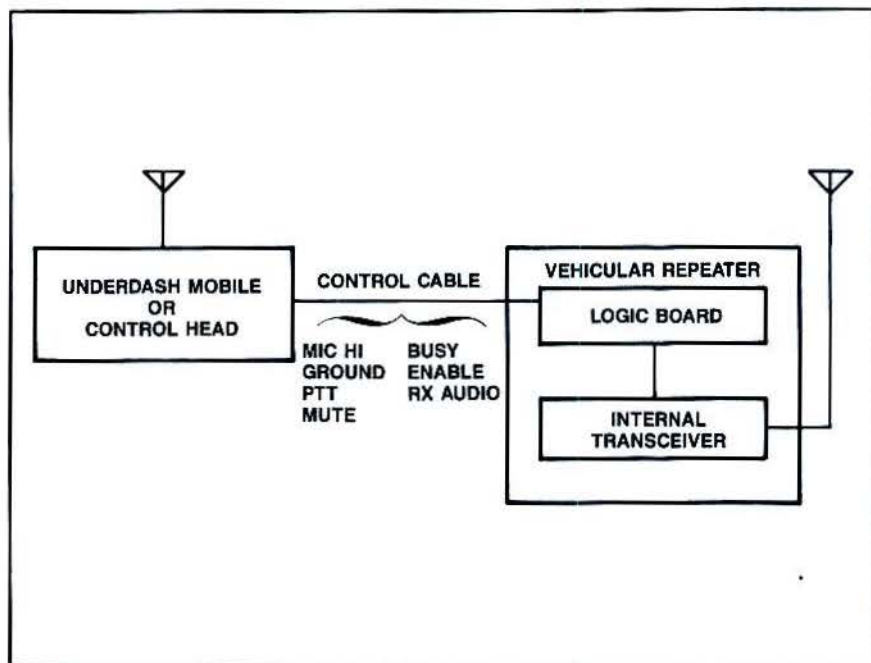


Figure 1. One version of a vehicular repeater uses a hand-held portable as the internal transceiver. The logic board provides switching functions and acts as an interface between the two transceivers. A

control cable between the vehicle repeater and the existing mobile radio carries signals, switching commands and voltages including mic hi, ground, PTT, mute, busy, enable and receive audio lines.

as frequency hopping and voice scrambling, is important.

Functional description

Figure 1 at the left shows a block diagram of a universal vehicular repeater system.

The logic board connects with the repeater's internal portable transceiver or an optional external transceiver, and with the vehicle's existing mobile radio. Signals, switching commands and voltages carried between the logic board and the transceivers are the same: mic hi, ground, push-to-talk (PTT), mute, busy, enable and receive audio. Only the existing mobile transceiver's portion of the interface is described in the following section.

The interface plug PI's mute line connects transmit-receive switching functions. The mute line connects to the mobile's squelch circuit at a point where a voltage changes when carrier or a proper continuous-tone coded squelch system (CTCSS) signal is received.

A comparator monitors the mute line



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Vehicle repeater components

- ☐ Simplex transceiver
- ☐ Logic board
- ☐ Mobile interface cables

and can be adjusted for analog or for digital voltage level thresholds. It is used to key the internal transceiver when the mobile transceiver's squelch opens.

Using the squelch mute line provides instant, positive switching of the repeat function and prevents words from being clipped, as would happen with a voice-operated (VOX) circuit.

Repeated audio is maintained at high quality because it is taken from the receiver's discriminator circuit prior to the de-emphasis and audio muting stages. To compensate for different discriminator audio levels, a 20dB audio pad may be inserted; an operational amplifier serves as a buffer and provides

any necessary gain.

The audio is fed to a switched-capacitor audio bandpass filter with cut-off frequencies of 3,400Hz and 260Hz. A crystal controls the filter's clock frequency, which in turn controls the capacitor switching to set the bandpass. Loss at CTCSS frequencies is in excess of 15dB.

Filtered audio is de-emphasized by a resistor-capacitor (RC) circuit according to the Electronic Industries Association (EIA) standard.

Mobile audio is routed through a complementary metal-oxide semiconductor (CMOS) switch and a buffer amplifier to drive the mic hi circuit in

the repeater's internal portable transceiver. A jumper is used to insert a series resistance to bring the audio level within the range of the internal transceiver.

The mobile PTT function is accomplished by a dual in-line package (DIP) relay contact closure. A jumper selects closure to ground or to +13.8Vdc. Closure occurs when a signal is received by the repeater's internal portable transceiver.

Monitoring

The "busy" line is used only with mobiles equipped with CTCSS or digitally controlled squelch. Voltage from the mobile's busy line is delivered to the repeater to indicate the presence of a carrier on the mobile receive channel. The indication "enables" the channel monitor option board. With the channel monitor option, when the user momentarily keys the hand-held portable and the mobile channel is busy, the mobile receiver unmutes and the user hears ongoing communication on the channel.

The mobile mic hi line feeds repeat audio to the mobile transmitter.

The enable line activates the priority option board, which prevents multiple vehicular repeaters in the same area and on the same frequency from being keyed simultaneously.

Five light-emitting diodes (LEDs) indicate activity on the enable line, mobile mute line, mobile PTT line, internal portable transceiver mute line and internal portable transceiver PTT lines to make it easier to service the repeater and to make adjustments.

Optional functions

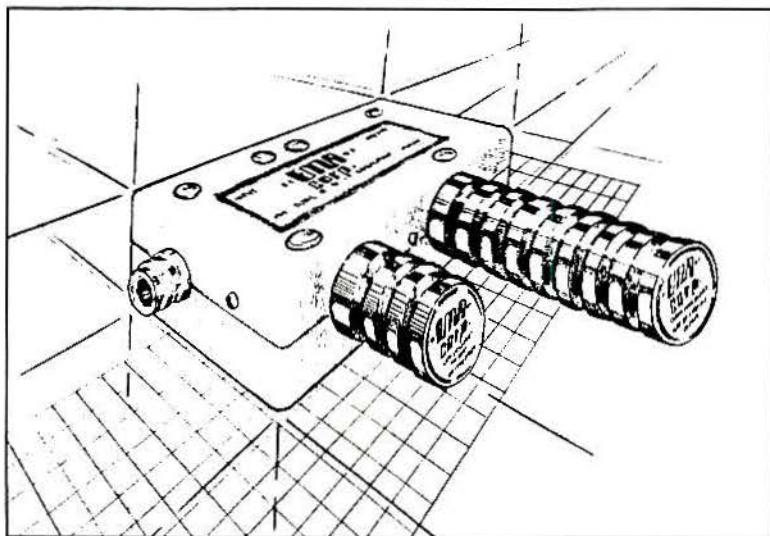
To fit different system requirements and to make it more versatile, the universal vehicular repeater offers acknowledgement, prioritizing, off-hook monitoring and receive sampling.

• **Acknowledgement**—It is vital for the user to know whether the user's hand-held transceiver is within range of the vehicular repeater. A tone acknowledgement option provides a positive indication by returning a 120ms burst of 1kHz tone on the vehicular repeater's frequency each time the hand-held's PTT button is released. The tone confirms that the hand-held's transmission activated the mobile's PTT circuit.

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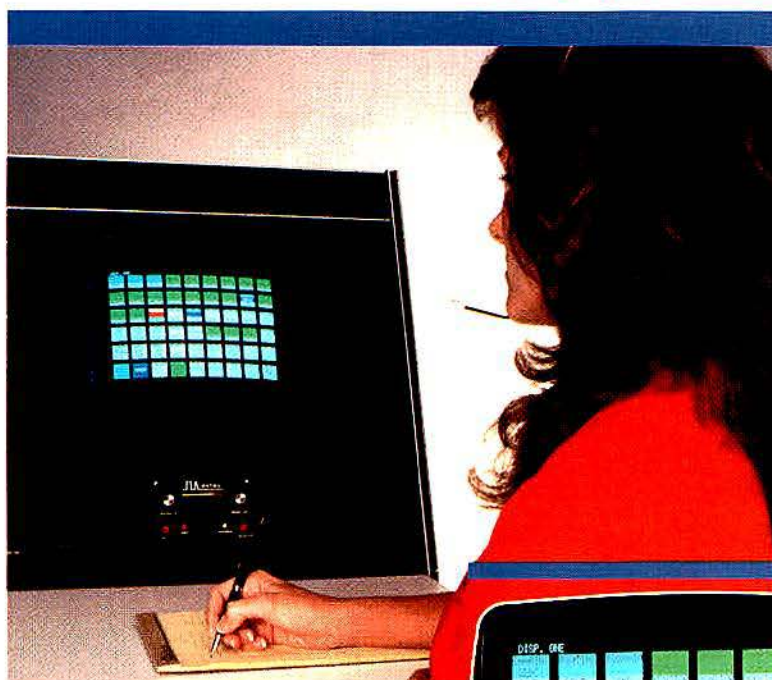
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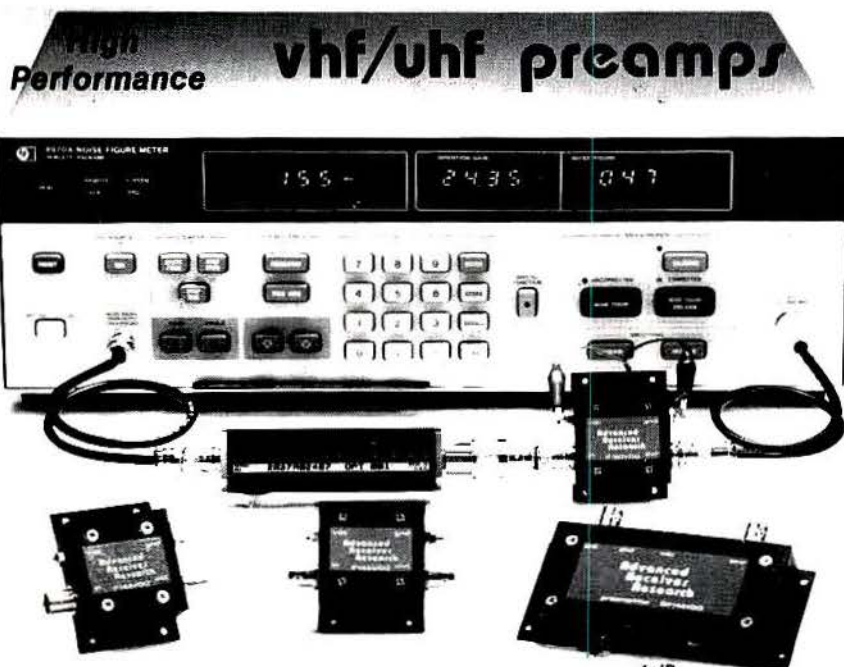
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Hand-held transceivers equipped with CTCSS may not revert to reception fast enough. To overcome the problem, the tone length may be increased. Alternatively, the user may switch the hand-held to its "monitor" position to override the CTCSS decoder.

• **Prioritizing**—With a prioritizing option installed in the vehicular repeater, multiple repeaters may be used to communicate in the same area without interfering with one another.

• **Off-hook monitoring**—Another option reconfigures the squelch function so that the mobile receiver is unmuted when the hand-held transceiver is keyed momentarily by its user. The option works with radios equipped for CTCSS.

• **Receive sampling**—Normally, it is impossible to interrupt a conversation conducted in full-duplex mode, as would be the case during the use of full-duplex telephone interconnect. It is impossible to interrupt because the vehicular repeater's receiver mutes while transmitting to the user's hand-held radio.

With receive sampling interrupt, the vehicular repeater's transmitter periodically is unkeyed to allow the user access to the radio system.

Additional applications

The typical use for a vehicular repeater is to extend the range of a portable transceiver when it is used near a mobile unit.

The vehicular repeater may be used to allow conventional portables to operate on a trunking repeater.

A vehicular repeater can extend the range of concealed wireless microphones ("body wires") used in covert activities.

A vehicular repeater can link a conventional radio system to a trunking repeater.

It can provide a crossband link between two radio systems. Such a link could connect services using different modes or bands, including single-sideband, marine FM and aeronautical VHF AM.

The universal vehicular repeater provides public safety agencies and commercial users with an economical way to improve and extend their communications with the technical limitations of existing radio systems.



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QUINTRON

Getting the most from your SINAD meter

Build a "matchmaker" to boost the usefulness of your SINAD meter or service monitor. The accessory helps you to connect a dummy load to the receiver output, to connect to balanced loads and to measure audio levels.

By Harold Kinley,
CET

Today's radio communications technicians face a tough challenge in servicing modern, high-tech radio gear. Any device that can simplify test setups and reduce servicing time is a welcome addition to the workbench. This article describes a simple device to construct as a complement to the SINAD meter.

SINAD meters

SINAD meters, such as the Sinadder 3 and Linear 5, provide four basic test functions:

- (1) an accurate, 1,000Hz tone generator.
- (2) a sensitive ac voltmeter with a decibel scale.
- (3) a fixed-tuned, 1,000Hz distortion analyzer with automatic level-setting.
- (4) an audio amplifier that provides aural monitoring of the input signal.

Even with these capabilities, the

Kinley is a certified electronics technician with the South Carolina Forestry Commission, Spartanburg, SC. His book is *Standard Radio Communications Manual: With Instrumental and Testing Techniques*, Prentice-Hall, 1985.

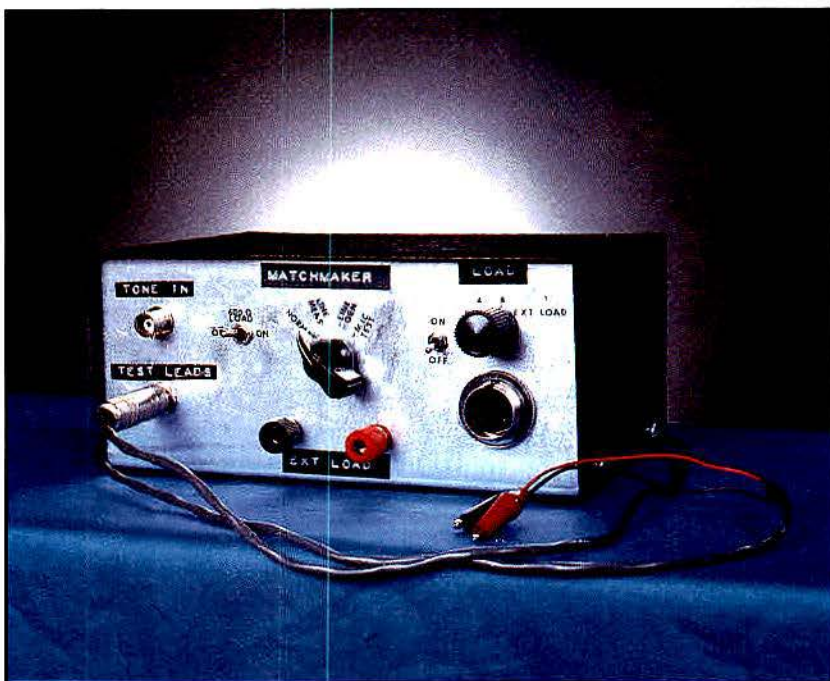


Photo 1. The completed matchmaker is housed in a box about the size of the SINAD meter.

usefulness of this instrument is virtually untapped. Modifying your SINAD meter and using a homemade test adapter can increase the instrument's versatility and usefulness greatly—and save you valuable time.

For service monitors, too

Many current service monitors provide most of the test functions that the SINAD meter does, so the homemade test adapter can be used with service monitors. The homemade test adapter is nicknamed "matchmaker" for the following reasons.

Some of the SINAD meter's and service monitor's shortcomings are:

(1) They do not provide a dummy load for connecting to the receiver's audio output.

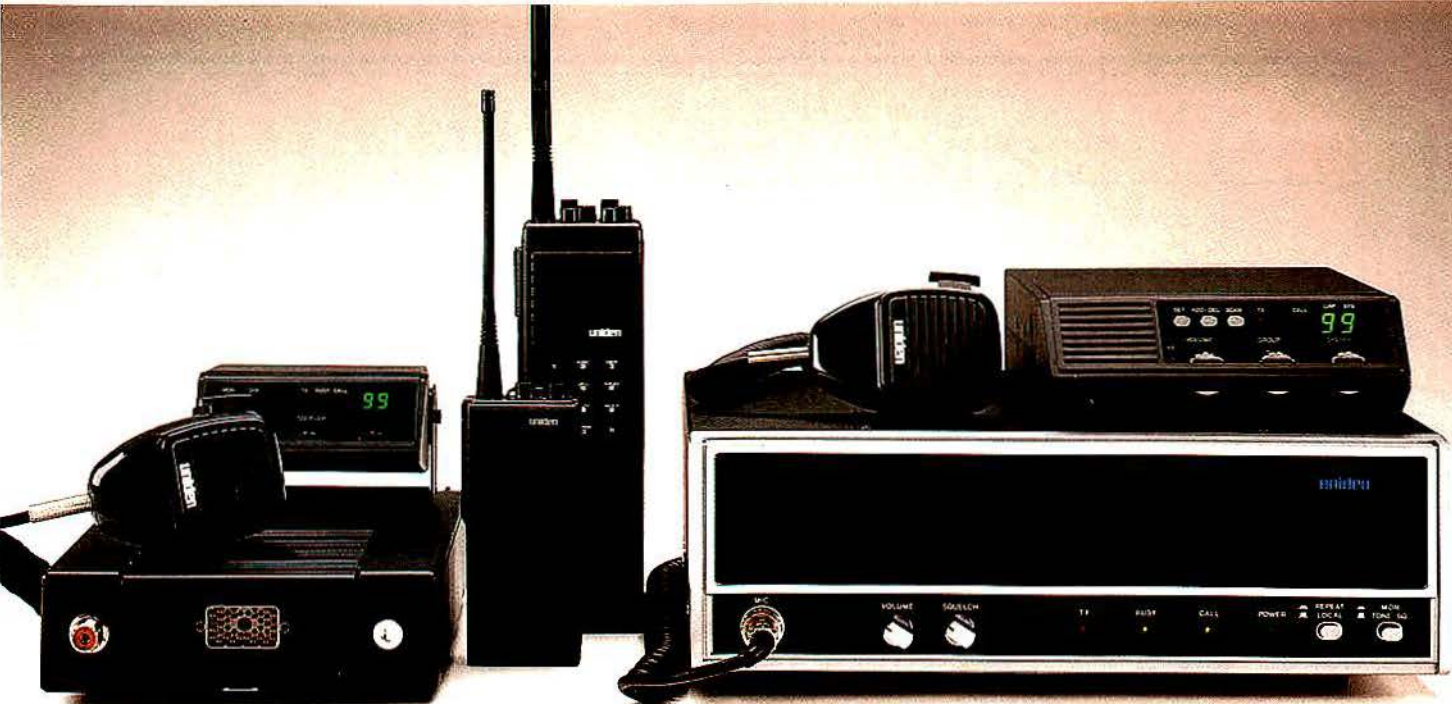
(2) Inputs and outputs are not balanced, so they cannot be connected directly to telephone lines. (The tone output of the Linear 5 is balanced.)

(3) They do not provide a convenient way to measure the audio level that is being applied from the instrument's output to the input of the device under test (DUT).

Service manuals for some SINAD meters made by Helper Instruments describe a simple device you can construct to connect between the SINAD meter and telephone lines. In fact, the idea for this project is based on that device. But this project goes much further and makes using the SINAD meter in a variety of applications easier and more convenient than ever.

'Matchmaker'

The matchmaker is small, inexpensive, easy to build and simple to use. Parts are readily available from Radio



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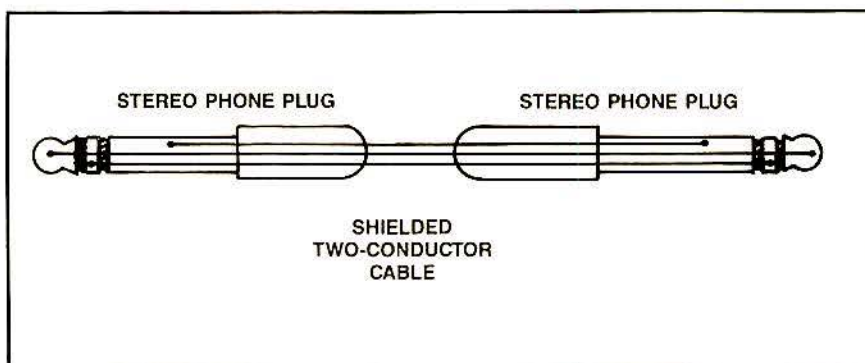


Figure 1. Wire the patch cord as shown for connecting the matchmaker to the SINAD meter.

Shack or other electronic parts houses. Point-to-point wiring is used throughout. Using 12-lug tie strips simplifies wiring.

The modification of the SINAD meter is minimal.

□ Cut the meter's permanently affixed test lead about 1 inch from the point where it enters the instrument through the strain relief and pull the stub into the cabinet.

□ Remove the strain relief and install

a 0.25-inch diameter stereo phone jack in the entry hole.

□ Inside the cabinet, connect the test lead stub to the stereo jack as follows:

Red lead to tip.

Black lead to ring.

Shield to sleeve.

The modification of the SINAD meter is complete.

□ Connect the remaining length of the test lead to a 0.25-inch stereo plug as follows:

Red to tip.

Black to ring.

Shield to sleeve.

□ Make a short jumper to patch the matchmaker into the SINAD meter. The jumper is a shielded, two-conductor cable such as the cable used for the test leads. Install a 0.25-inch stereo phone plug on each end of the jumper cable, connected as shown in Figure 1 at the left. The shield connects to the plugs, sleeve-to-sleeve. The inner conductors connect ring to ring and tip to tip.

How it works

Figure 2 on page 42 shows a schematic diagram of the matchmaker.

• *Position 1, "normal"*—In the "normal" position, the matchmaker switch connects the SINAD meter directly to the test leads. This position allows a dummy load to be connected across the leads for testing receivers.

The dummy load connects through switch S2. The value of the dummy load is selected by switch S4. An external ("EXT") position allows the user to

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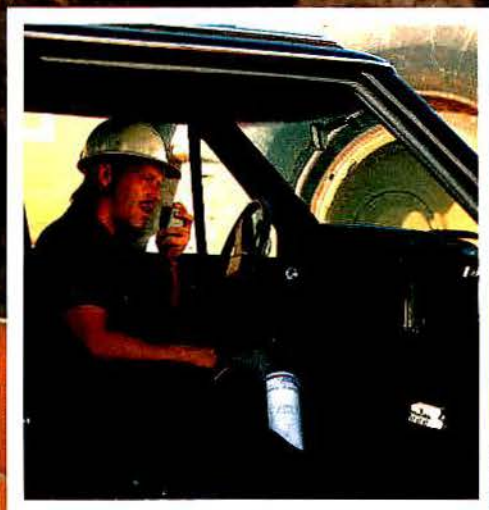
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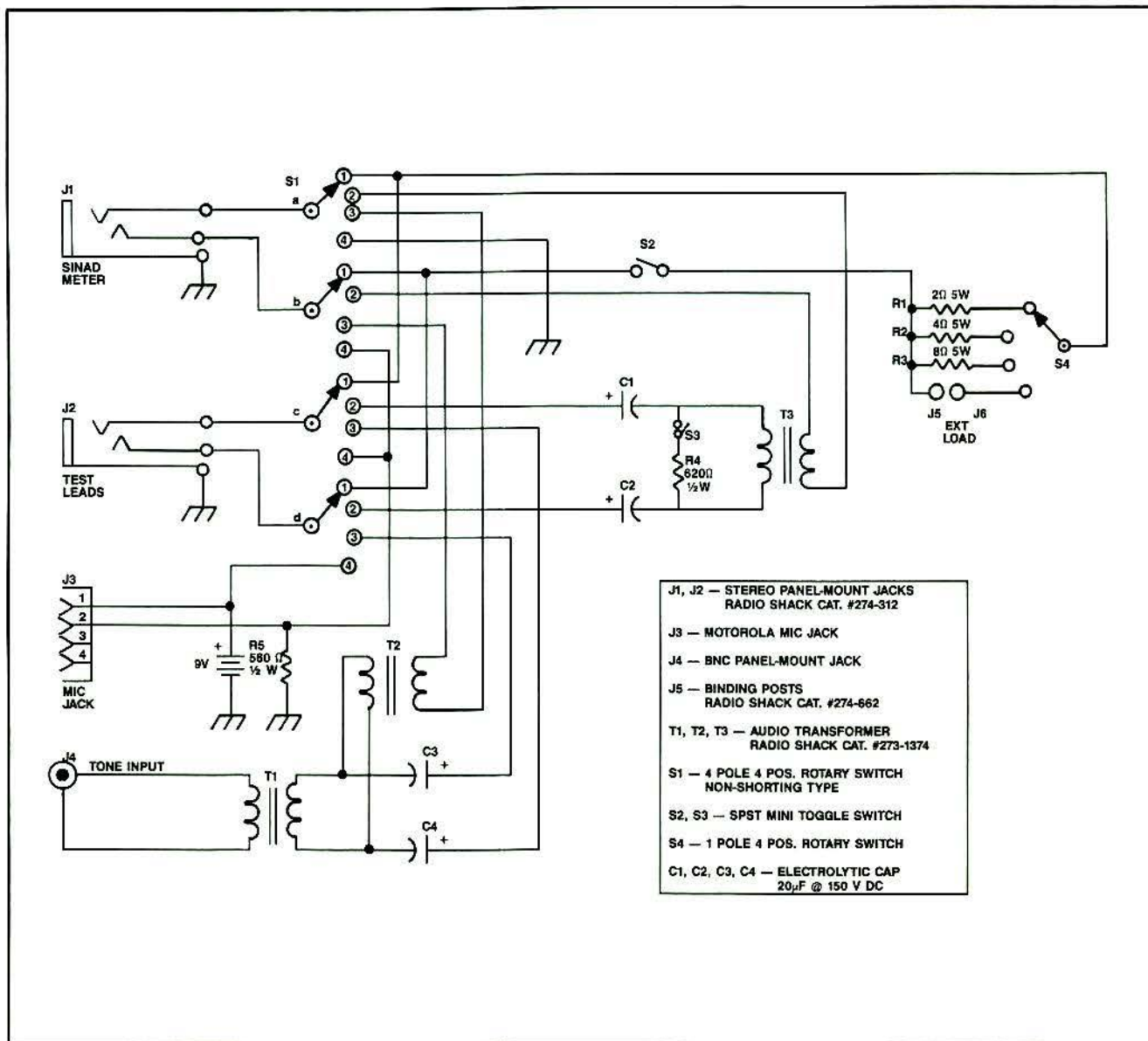


Figure 2. Schematic diagram of the matchmaker.

connect an external load resistor to binding posts J5 and J6 on the front panel.

- **Position 2, "line measure"**—In the "line measure" position, test leads connect to the SINAD meter through dc blocking capacitors C1 and C2 and through isolation transformer T3. The position allows the SINAD meter to be used across balanced telephone lines and other balanced circuits.

A 620 load resistor can be connected across the line via switch S3. The dc blocking capacitors allow the instrument to be used on lines where dc keying voltages may be present.

- **Position 3, "line generate"**—In the

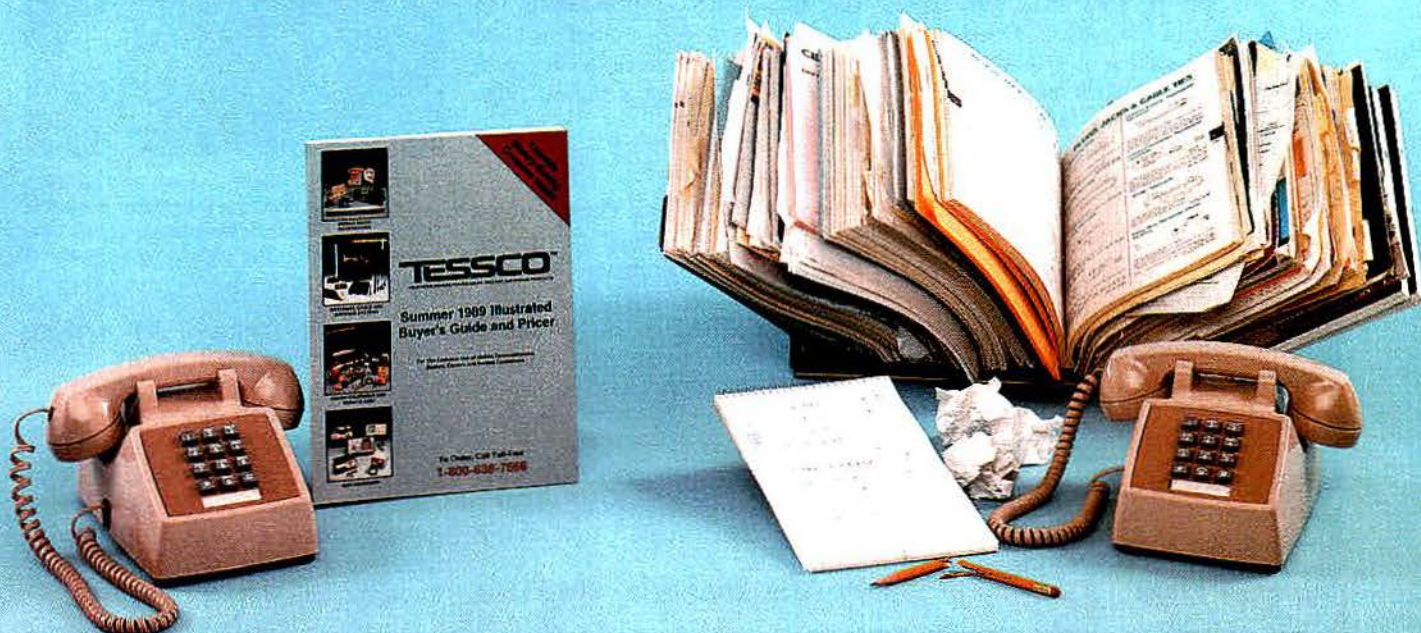
The dc blocking capacitors allow the instrument to be used on lines where dc keying voltages may be present.

"line generate" position, output from the SINAD meter's tone generator or other tone source connects to the matchmaker's "tone input," J4. The tone is coupled through isolation transformer T1 and blocking capacitors C3 and C4 to the test leads. The test leads then can be connected directly to a telephone line or other DUT for testing.

Transformer T2 couples the tone signal to the SINAD meter input so the tone signal level can be read directly on the SINAD meter in the ac volts position. This arrangement also is used for measuring the modulation sensitivity of a transmitter when the level of the

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modulating tone feeding the mic input must be measured.

• **Position 4, "mic test"**—This setup is designed specifically for testing Motorola pre-amplifier mic cartridges.

If you have little need to test these cartridges, you probably will want to omit this part of the project. Omitting this part reduces the requirement for S1 to a four-pole, three-position switch and eliminates the need for J3, R5 and the 9V battery.



Photo 2. The matchmaker and SINAD meter work hand-in-hand to reduce setup time for many tests.

In position 4, the mic can be plugged into mic jack J3 for testing, or the test leads can be hooked directly to the mic cartridge.

Be sure to observe polarity: red lead to positive; black lead to negative.

Use the ac volts position (100mV) to check the cartridge output as the SINAD meter's audio amplifier provides aural monitoring of the cartridge output.

Hooking it up

Photo 2 at the left and Photo 3 at the right show how to connect the matchmaker to the SINAD meter.

The matchmaker's usefulness is not limited to the SINAD meter. It is almost as useful with a service monitor, especially if the service monitor has ac voltmeter and SINAD meter functions. The matchmaker helps to overcome some of the service monitor's disadvantages: lack of aural monitoring and lack of a decibel scale for audio measurements.

To use the matchmaker with a serv-



Photo 3. The matchmaker and SINAD meter are patched together through stereo phone jacks on the rear panels of each instrument, using the patch cord shown in Figure 1.

ice monitor, connect the service monitor's tone output to the matchmaker's tone input. Patch the matchmaker into the service monitor's ac voltmeter and/or SINAD meter input, or to the vertical input of the scope to view the waveform. Some service monitors provide access to the SINAD meter, ac voltmeter and scope functions through a single input connector.

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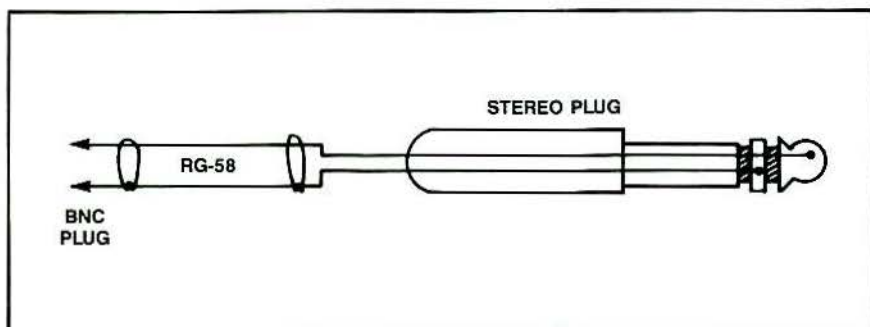


Figure 3. A patch cord wired like this can be used to connect the matchmaker to a service monitor.

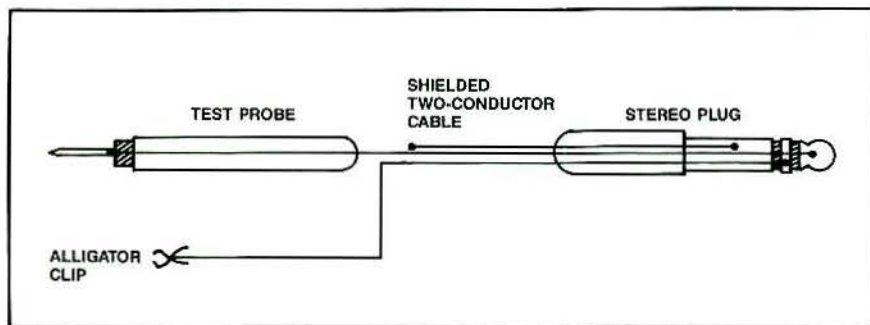


Figure 4. This test probe is handy to use with the SINAD meter for tracing signals or distortion.

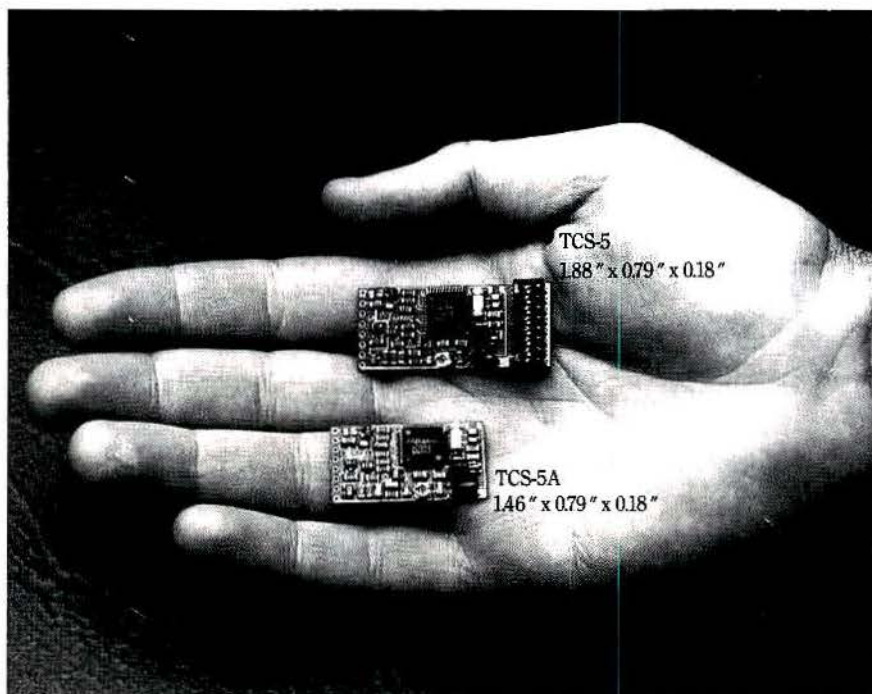
A different patch cord is necessary for patching between the matchmaker and the service monitor. Fashion the patch cord from a length of RG-58 coaxial cable. Install a male BNC connector on one end, a 0.25-inch stereo phone plug on the other. Figure 3 at the left shows the wiring for the patch cord.

Winding up

Another advantage of modifying the SINAD meter with the stereo jack for connecting test leads is that you can make another set of test leads with a test probe for signal-tracing or checking ac voltages. A test probe specifically designed for the purpose is much better to use than the alligator clips affixed to the permanent test leads. Figure 4 at the left shows how to make a simple test probe.

The time and care you put into this project should reward you with an instrument that simplifies your test setups, maximizes the use of your SINAD meter and serves you well for years to come.

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Simple calibration for deviation measurements

Use a spectrum analyzer and a tone generator to calibrate deviation measurement instruments. With this technique, your radio communications service monitor can be used to calibrate itself!

By Paul C. Bunnell

It is important to make accurate deviation measurements for FM transmitters. Deviation set too low can reduce system range and cause an apparent increase in noise on the signal. Deviation set too high can cause interference and distortion.

Setting deviation "just right" can be done with a service monitor that includes a spectrum analyzer, but only if the test instrument itself is accurate.

The method described below allows you to calibrate the service monitor and spectrum analyzer accurately. The calibration method is based on precise mathematical relationships between the modulation tone level, tone frequency and deviation as determined by Bessel functions.

Table 1 at the right shows the solution to the equation:

Tone (Hz)

= Deviation (Hz) / 2.40483

where the constant, 2.40483, comes from the value of the Bessel function at the first carrier null.

Procedure

For example, set the tone level for a deviation of 5kHz. From the table, the tone frequency is 2,079.2Hz.

As you monitor the carrier on the spectrum analyzer, slowly increase the tone level until the carrier reaches a minimum. At this point, the deviation is exactly 5kHz. Use this setting to

Bunnell is an engineering consultant in San Marcos, CA.

Setting deviation 'just right' can be done with a service monitor...

check the calibration of any instruments that read deviation, including the service monitor.

Tone frequency accuracy is not critical because a tone-frequency error of 10Hz translates into a deviation error of about 24Hz.

Nevertheless, the tone's waveform should be as close to a sine wave as possible. Any distortion causes the carrier to null at a different point than the equation predicts.

Table 1—Deviation at the first carrier null, based on solutions to the equation:

$$\text{Tone (Hz)} = \text{Deviation (Hz)} / 2.40483.$$

| DEVIATION (Hz) | TONE (Hz) | DEVIATION (Hz) | TONE (Hz) |
|-------------------|--------------|-------------------|--------------|
| 500 | 207.9 | 8,000 | 3,326.6 |
| 1,000 | 415.8 | 8,500 | 3,534.6 |
| 1,500 | 623.7 | 9,000 | 3,742.5 |
| 2,000 | 831.7 | 9,500 | 3,950.4 |
| 2,500 | 1,039.6 | 10,000 | 4,158.3 |
| 3,000 | 1,247.5 | 10,500 | 4,366.2 |
| 4,000 | 1,663.3 | 11,500 | 4,782.1 |
| 4,500 | 1,871.2 | 12,000 | 4,990.0 |
| 5,000 | 2,079.2 | 12,500 | 5,197.9 |
| 5,500 | 2,287.1 | 13,000 | 5,405.8 |
| 6,000 | 2,495.0 | 13,500 | 5,613.7 |
| 6,500 | 2,702.9 | 14,000 | 5,821.6 |
| 7,000 | 2,910.8 | 14,500 | 6,029.5 |
| 7,500 | 3,118.7 | 15,000 | 6,237.5 |

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Expo/East preshow overview



The Orange County Convention/Civic Center in Orlando, FL, hosts the eighth annual Expo/East.

Showcasing their latest equipment, more than 100 exhibitors will convene in exhibit halls B and C of the Orange County Convention/Civic Center in Orlando, FL, on Sept. 7-9 for the eighth annual Land Mobile Expo/East.

Industry giants and smaller, product-specific manufacturers will display land mobile products such as radio-telephones, interconnect equipment, batteries, test equipment, data transmission equipment, tone signaling and control equipment, paging equipment and accessories, antennas, towers and cellular equipment.

A "New Product Introduction

Center" will feature innovative products in a convenient location on the exhibit floor. Conventioneers will have an opportunity to vote for the most progressive product in the center.

The keynote luncheon is Thursday, Sept. 7, from noon to 2 p.m.

Sessions will cover leading technology, communications equipment maintenance, regulations and emerging technologies.

Mobile Radio Technology will be exhibiting in booth 209. Stop by and pick up a copy of the latest issue. Other details about the show were incomplete at press time.

Event: Land Mobile Expo/East

Dates: Sept. 7-9

Location: Orange County Convention/Civic Center

City: Orlando, FL

Number of Exhibitors: 125 to 150

Projected Attendance: 2,500

Exhibit Hours: Thursday, Sept. 7, 2 to 6 p.m.

Friday, Sept. 8, 10 a.m. to 5 p.m.

Saturday, Sept. 9, 8 a.m. to 1 p.m.

Seminar Schedule: To be announced.

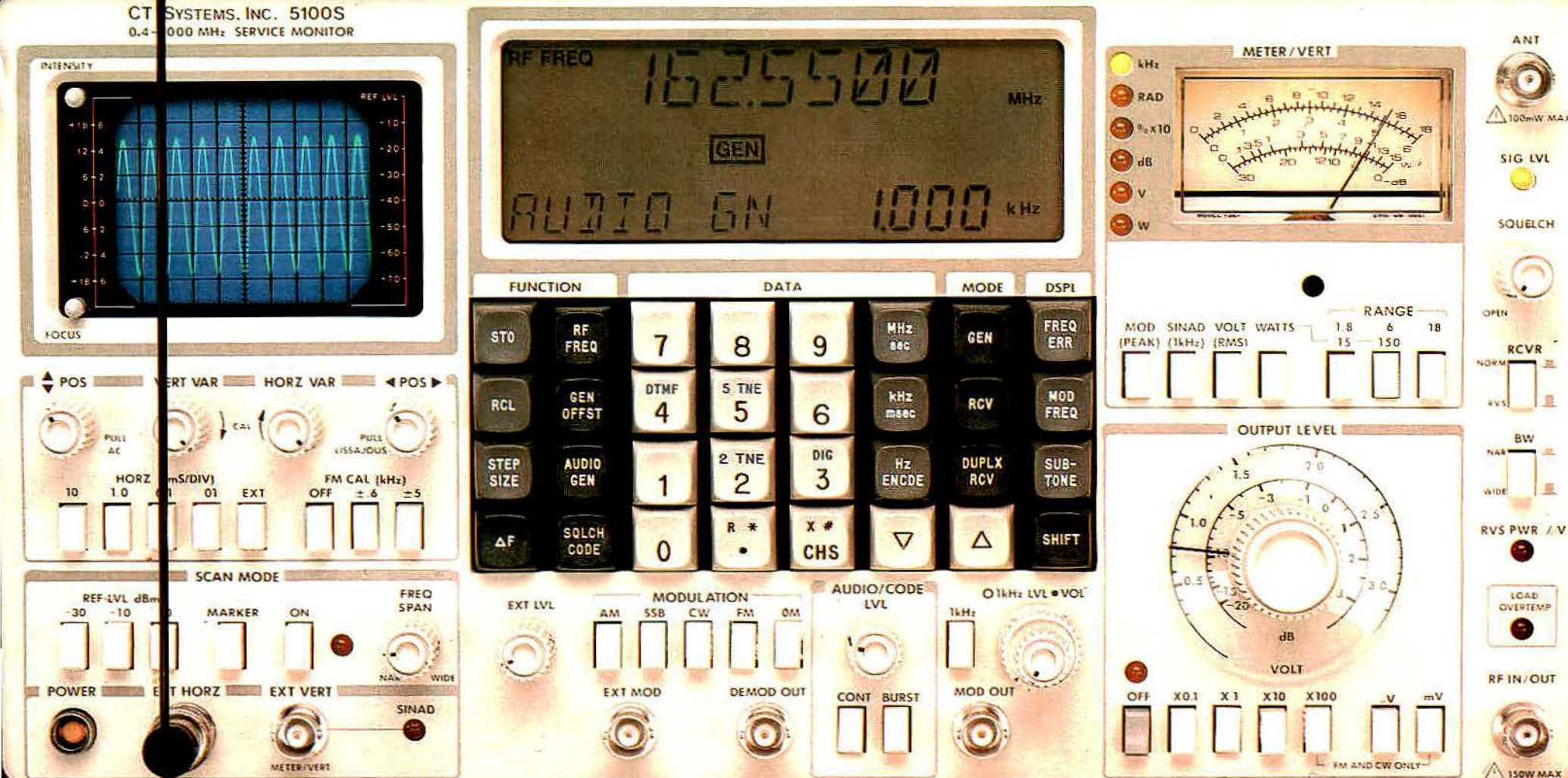
Registration/Hotel Information: 303-220-0600

To help you choose booths to visit, check the products and services that interest you and take this list to Expo/East. At the show, refer to the show guide to find manufacturers exhibiting this equipment.

- ☐ Accessories and hardware
- ☐ Amplifiers and chargers
- ☐ Antennas and antenna system accessories
- ☐ Auxiliary equipment and services
- ☐ Base station repeaters
- ☐ Batteries and chargers/analyzers
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- ☐ Paging equipment and accessories
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Hunt, Andrew, Glenayre buy Alliance; Glenayre to acquire BBL, Quintron

Alliance Telecommunications is selling Decibel Products, Dallas; BBL Industries, Atlanta; Alliance Frequency Management Group, Dallas; and its 52% interest in Quintron, Quincy, IL. Meadows Resources, a subsidiary of Public Service Company of New Mexico, owns 80% of Alliance Telecom.

• **Alliance Acquisition**—Decibel Products and Alliance Frequency Management Group go to a new holding company, Alliance Acquisition, formed by William O. Hunt. Hunt was chairman of Alliance Telecom until October 1988. Investors with Hunt in Alliance Acquisition include Glenayre Electronics, Toronto, and Andrew, Orland Park, IL.

• **Glenayre Electronics**—BBL Industries and Alliance Telecom's 52% stake in Quintron go to Glenayre Electronics. Glenayre has arranged to buy the remaining 48% of Quintron, as well.

"The acquisition of BBL and Quintron will significantly enhance

New owners

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- ☐ BBL Industries
- ☐ Quintron

Alliance Acquisition*

- ☐ Decibel Products
- ☐ Alliance Frequency Management Group

*Investors include Glenayre Electronics, Andrew Corporation and William O. Hunt.

Glenayre's capability to service our customers in the global marketplace," said Glenayre president J. John Hurley. The transaction is expected to bring approximately \$50 million worth of annual sales to Glenayre and position it as a prominent supplier of paging and voice mail products in North America.

Glenayre and BBL both manufacture paging terminals. Glenayre also makes paging transmitters.

Decibel Products makes antennas, monitoring systems and fiber-optic transmitters and receivers.

Quintron makes transmitters, simulcast controls, auxiliary equipment and systems for paging and mobile radio.

Alliance Frequency Management Group provides spectrum analysis and related services.

Andrew makes coaxial cable, microwave antennas, towers and antenna system accessories.

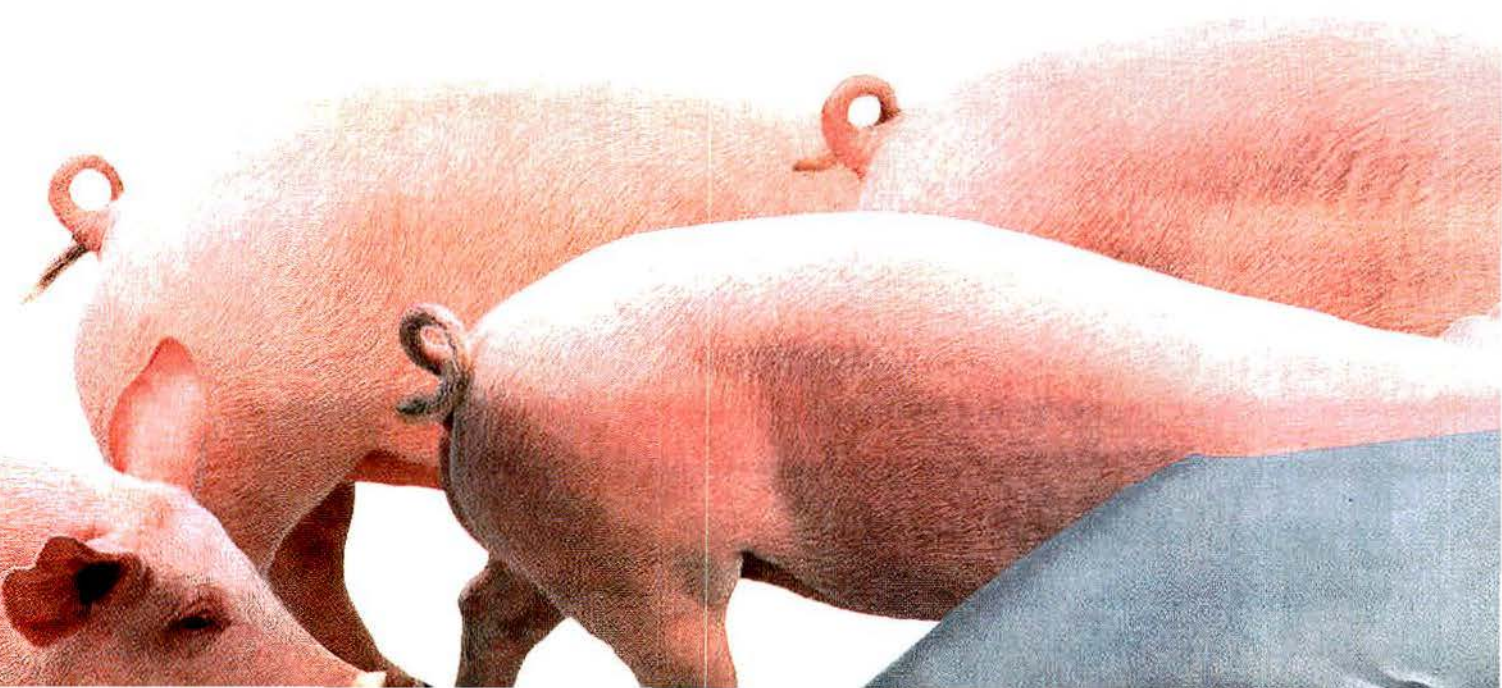
A NEW LITTLE PIGGY

There's a new pigtail in town: The all new Larsen® KG-825 On-Glass Cellular Antenna.

It's sleek. Sexy. With a high-tech European look designed for performance as well as appearance—distinctively more elegant than its competition. The KG-825 also sports a small "footprint" which conforms

easily to the erratic curves of today's automobile glass.

Technically speaking, the KG-825 is the most advanced antenna we've ever made. We've placed its patented* impedance-matching circuitry on the outside of the glass with the radiating element, creating a low impedance power transfer through the glass. No tuning is required.



GE presents award

Communi-Con, Flint, MI, has received General Electric Mobile Communication division's "Quality #1" award for maintaining the standard of excellence associated with the GE name.

NJ Bell, Martin Marietta purchase SCE paging systems

New Jersey Bell has purchased additional expansion cabinets and a PX Plus concentrator from SCE, Hicksville, NY, to increase its trunk capacity for its paging system. In the expansion, the concentrator will be networked to the PX2000 main system and provide additional service.

Martin Marietta Energy Systems, a Department of Energy contractor, also bought an SCE PX Plus. The company installed the paging and voice messaging system in its Oakridge, TN, plant. The system is expected to activate 5,000 to 6,000 voice mail boxes within the first year.

Tessco consolidates distribution centers

Tessco, Hunt Valley, MD, is closing its Tampa, FL, and Chicago regional distribution centers in a consolidation move. The company continues to operate its Baltimore and Reno, NV, distribution centers as "Super Centers."

Warehouse space will be increased in the "Super Centers," and consequently, the company will stock more product lines. The company's advanced com-

puter system will be upgraded with bar coding to improve order entry speed and inventory control.

The company's plan to improve customer service includes:

- increasing the number of customer coordinators.
- increasing the technical adviser staff.

Nokia to provide trunked network in Finland

Nokia Telecommunications of Finland will provide local telephone companies in Finland with a trunked private mobile radio network. The service will commence in the fall with the Helsinki Telephone Company. During the rest of 1989 and 1990, the network will be extended to cover most of the cities in Finland. Subscribers are expected to exceed 10,000. The network's

value is expected to exceed \$20 million.

The telephone companies will offer the trunked mobile service to businesses within their operating areas. Nokia's trunked Actionet network offers open channel communications, emergency and priority calls, group calls and a variety of user terminals for speech and data communications.

GOES TO MARKET.

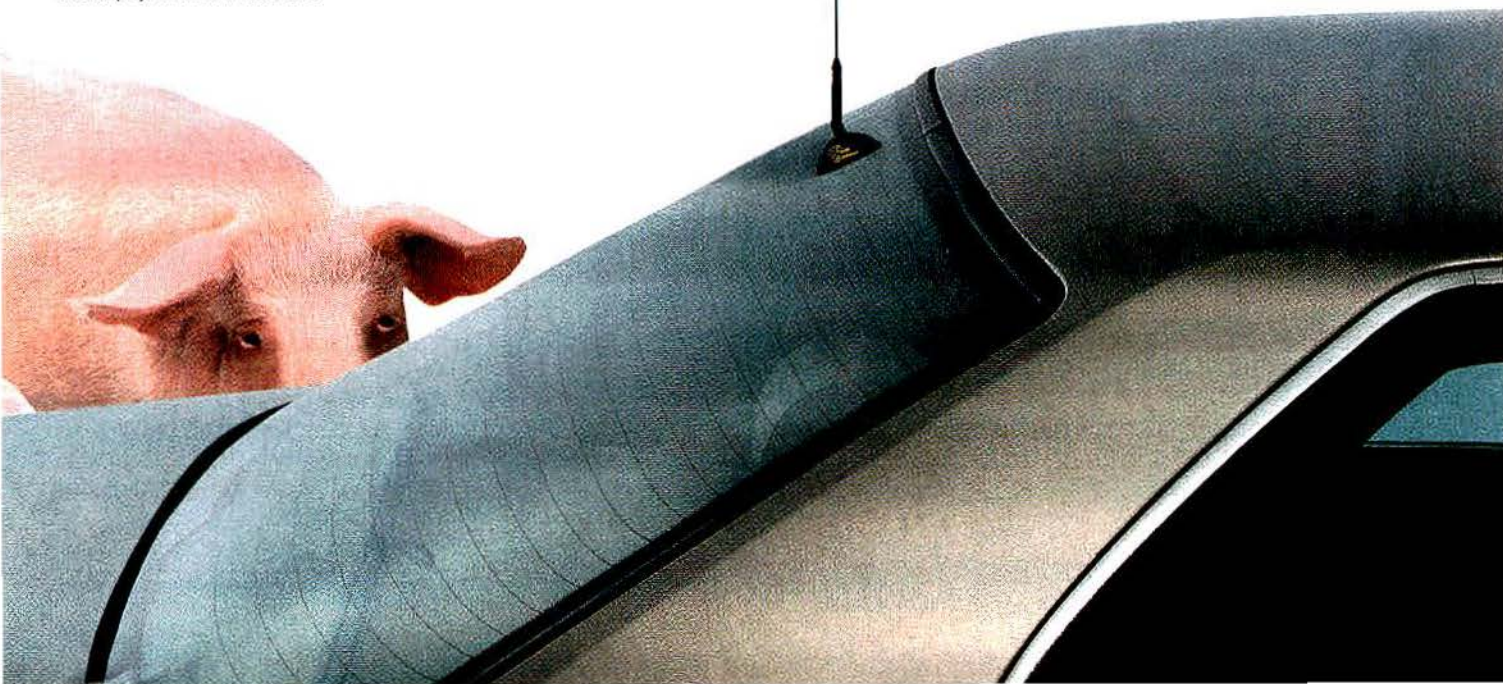
Translation? Peak performance right out of the box. See the new KG-825 at your Larsen dealer today. It's one pigtail that has all others wagging behind.

IN U.S.A.: call toll free 1-800-426-1656. (In Va. 1-800-562-1747); **IN CANADA:** call toll free 1-800-663-6734. Larsen® is a registered trademark of Larsen Electronics, Inc. *Külglass™ antenna series patent #4,764,773

Circle (43) on Fast Fact Card



Larsen® Antennas



C.I.A.

Custom Interface Accessories

LEADS THE WAY TO CELLULAR'S FUTURE PROFITS!



Deborah



Frankie

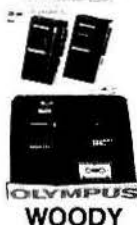


Kathy

The CIA Agents

THE ROAMER

A wireless pager beeps you as you're receiving a call. Incredible low price!



WOODY

Our Woodbury Cellular Interface is the hot new money maker. We package with an Olympus

microcassette recorder which automatically records both sides of conversation through voice activated circuitry. The biggest breakthrough in safety since **HANDS FREE**. **OUR PRICE IS UNBELIEVABLE!**

DASH-PAK

Slip your Panasonic battery into this tiny fast charger. 90% charge in 1 hour — car on or off! Turns off when done. Mount under dash or trunk.



Our new **KINTEK MOBILIZER** portable kits have redefined the term "state of the art" for the cellular industry!



AUDIOVOX



N.E.C.



FUGITSU



MOTOROLA

- Regulated, supervised fast charging — car on or off
- A.C. supply so powerful you can talk while on A.C.
- **HANDS FREE** built-in on some models
- Low voltage cutoff — prevents deep discharge
- Surge suppression — Protects from spikes
- Bicolor L.E.D. for instant charge status
- 2-year warranty parts and labor
- Car kits also available



INTELLICHARGER — A.C. to D.C. quick charging, automatic shutoff, bicolor L.E.D. status indicator, small and lightweight, 3-stage regulated, fully supervised.

*** **UNDER \$35.00** ***

THE HOT TIP

The new C.E.S. high performance 3dB glass mount has quietly been making a lot of money for dealers while providing a trouble-free quality reception for the customer. **Testing is believing** and we make it very attractive for you to do so — **CALL FOR DETAILS.**

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News

All City picks BBL for voice processing trial

All City Communication, Milwaukee, WI, has picked BBL Industries, Atlanta, for a voice messaging trial. All City is conducting the trial for Wisconsin Bell. All City offers three services to end-users in the trial: Message Manager, Message Manager-Alert and Voice Messenger. In the first 2½ weeks of the test, 700 customers signed up for the service.

Another MVP system is being installed by Southwestern Mobile Systems in Oklahoma City.

Celwave names award winners

Celwave, Marlboro, NJ, has established a "Million \$ Club" for representatives selling \$1 million worth of its equipment. Two charter members were presented awards at the International Mobile Communications Expo in Las Vegas, NV: RJB & Associates, Denton, TX, and Communications Marketing Southwest, Marietta, GA.

At the show, the company presented Rodney Franklin of Cellstar an award for purchasing No. 500,001 Glass Advantage glass-mount antenna.

TPL Communications presents rep awards

TPL Communications, Los Angeles, presented Arva Hudson, Bellevue, WA, its sales representative of the year award. Webster Associates, Rochester, MI, was honored as the top manufacturers representative and was presented the Sterling Award.

Daniels wins awards

Daniels Electronics, Victoria, British Columbia, has received two awards for developing its MT 2 series solar-powered mountaintop repeater.

The Government of British Columbia, in liaison with the Electronic Manufacturers Association of British Columbia, gave Daniels its "Award of Excellence for Innovation in Electronics."

The Applied Science Technologists and Technicians of British Columbia gave the company its "Advanced Technology Award."

BEST

SIMPLEX PATCH AVAILABLE



VCS-2100 VOX CONTROLLED SAMPLING INTERCONNECT

The Interconnect Specialists Inc. (ISI), VCS-2100, uses a combination of VOX control from telephone line audio, and sampling of receiver noise, to achieve the optimum control method for a simplex interconnect. No sampling interruptions occur during normal conversation. Turn-a-round beeps make operation very smooth and easy.

The VCS-2100 features the ISI exclusive, Automatic Setup. This feature eliminates the trial and error method of sample window setup. Our Quick Start Set-up procedure gets the VCS-2100 up and running, without complicated programming. The VCS-2100 is superior to any other interconnect in its price range. It is a plug-in replacement for the popular 510SA Smart Patch.

FEATURES:

- **AUTOMATIC SET-UP**
Automatically sets the sample window for your transceiver. No more trial and error.
- **TURN-A-ROUND BEEPS**
Sends beep to telephone line, and to mobile indicating it's their turn to talk.
- **USER PROGRAMMABLE CW ID**
CW ID can be programmed using DTMF. ID can be programmed to be sent at the beginning, the end, both, or not at all.
- **AUTOMATIC BUSY DISCONNECT**
Automatically disconnects if the telephone number dialed is busy.
- **HOOK-FLASH**
Used to make a second call without disconnecting and re-connecting. Also can be used for phone company services which use Hook-flash.



• CALL WAITING

If a mobile call is attempted and the line is in use, a beep is sent to the phone line indicating that the mobile wants to make a call. Then when the line becomes available, a ring-out is transmitted to the mobile.

• RING-OUT (REVERSE PATCH)

Can be programmed to ring-out one time, on each ring, or not at all, when the line rings.

• SINGLE OR MULTI DIGIT CODES

Connect or disconnect codes can be single * and #, or * and # plus two digits.

• CALL LIMIT TIMER

Can be set for 3, 4, or 5 minutes, or disabled. Can be programmed to reset with *.

• MOBILE ACTIVITY TIMER

Causes disconnect if mobile drives out of range. Can be set to 30, 45, 60, or 90 seconds.

• TOLL RESTRICT

The first digit dialed cannot be a "1" or a "0". Rearms after dialing is complete.

• PHONE LINE IN USE INHIBIT

Prevents interrupting a call when the patch shares the telephone line with a telephone.

• TOLL RESTRICT DEFEAT CODE

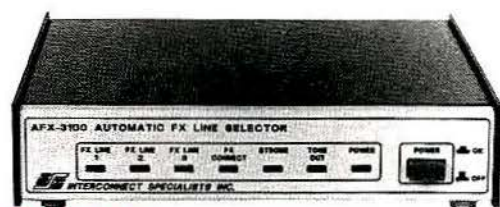
A special programmable code allows toll calls. Also allows access to line, even if line is in use.

• TONE OR PULSE DIALING

Switch programmable for Tone or Pulse dialing. Pulse dialing can be used on a tone line.

• HALF DUPLEX MODE

The VCS-2100 can be used as a repeater interconnect in this mode.



AFX-3100 AUTOMATIC FX TELEPHONE LINE SELECTOR

The AFX-3100 automatically routes mobile telephone calls to one of four trunk lines, as determined by the first three digits (exchange code) of the telephone number dialed. One local line and three FX lines can be accommodated. Up to 640 exchanges can be assigned to any of the three FX lines. A built-in keyboard is provided for programming of FX exchange numbers. Local line exchanges need not be programmed.

- **HANDLES BOTH INCOMING AND OUTGOING CALLS**
- **COMPLETELY TRANSPARENT TO THE MOBILE USER**
- **NON-VOLATILE MEMORY REQUIRES NO BATTERY BACK-UP**
- **RS 232 SERIAL PORT FOR PROGRAM VERIFICATION**

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Circle (46) on Fast Fact Card

News

Antenna Specialists, Telular sign marketing agreement

Antenna Specialists, Cleveland, and Telular, Wilmette, IL, have established a licensing agreement that allows both companies to sell fixed cellular telephone products. Earlier, both companies dropped patent infringement suits against one another. The lawsuits had to do with each company's fixed cellular telephone products.

Motorola, Northern Telecom furnish Hong Kong system

Motorola Asia Limited and Northern Telecom will install a \$36 million integrated communications system to the Royal Hong Kong police force. The system will extend radio coverage in newly developed areas in the New Territories, improve existing coverage of Hong Kong Island, Kowloon, and the outlying islands, and upgrade fixed police communications facilities.

Easi-Set secures franchise

Easi-Set Industries, Midland, VA, has added Associated Concrete Products, Santa Ana, CA, as a franchise for its precast concrete products, including equipment shelters. The Easi-Set precast concrete building measures 10 feet x 12 feet and requires no foundation.

Syntonic opens four offices

Syntonic, Harrisburg, PA, has opened four new offices. These include:

- 520 Fellowship Road, Suites E-503-505, Mt. Laurel, NJ 08054; sales, 800-544-5159; service, 800-544-5158.
- 102 Quigley Blvd., New Castle, DE 19720; sales, 800-544-5159; service, 800-544-5158.
- 58 Jerseyville Ave., Freehold, NJ 07728; sales, 800-544-5159; service, 800-544-5158.
- 550 Brook Road, Conshohocken, PA 19428; 215-941-9899.



POWER ATTENUATORS!

300 WATT

100 WATT

50 WATT

30 WATT

10 WATT

5 WATT

2 WATT

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Indianapolis, Indiana 46237
(317) 887-1340

JFW Fast Delivery

Circle (47) on Fast Fact Card

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Affordable Wireless Data Recorder

At only \$595.00 printed communication between base station computers and mobile units is now affordable for everyone. The AR1200

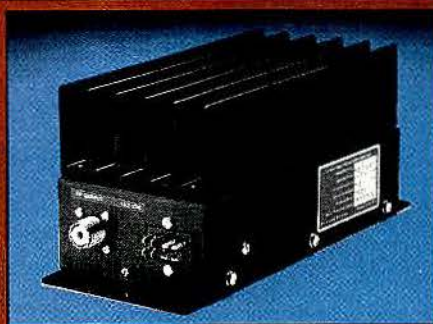
stores and prints messages or receives and prints simultaneously. Easy to operate; compact size; full 40 characters per line printer output.

Also available, other computer and data transmitting products.



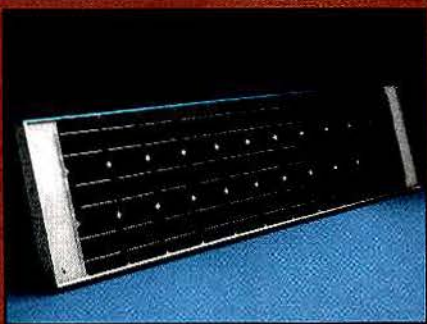
Tempo™ Mobile Radios

Economical, reliable mobile transceivers are available for immediate shipment. Several models offer a choice of features to the two-way customer. Type accepted for all business and public safety uses.



RF Power Amplifiers

We've got RF Amplifiers in stock. Delivery when you need it. Guaranteed to specs, year after year. We've got our dependable reputation behind these products and offer them at realistic prices. You can count on Henry Radio!



Hoxan™ Photovoltaic Products

The reliability of Hoxan solar products is backed by a 10 year guarantee. True quality that lets you enjoy complete independence from utility lines or fuel storage tanks. Completely modular units can add or subtract from a system easily. Reliability, independence, modularity, economy, safety. Henry Radio is your best choice for communications power.

*Over a half-century of
reliability in communications.*

Also in stock: ASTRON Power Supplies, CUSHCRAFT Antennas, LARSEN Antennas, MAXCOM Antenna Tuners, PIPO Tachtone Pads, MAG INSTRUMENTS Flashlights plus much more two-way and amateur radio equipment and supplies.



HENRY RADIO

2050 S. Bundy Drive, Los Angeles, CA 90025; toll free:
1-800-877-7979; FAX: 1-213-826-7790

Circle (48) on Fast Fact Card

Association of Communications Technicians seeks trade school instructors

Trade school and two-year college instructors who know about the Association of Communications Technicians (ACT) are in the best position to inform prospective new members about the industry's only organization devoted to communications technicians. ACT is a membership section of the National Association of Business and Educational Radio.

But according to a staff report made to the ACT council during its March meeting, the task of gathering the names and addresses of instructors is formidable. John Sherlock, director of membership and communications for NABER, said: "The problem is to find the name of the communications instructor so mail addressed to the trade school reaches the right person."

As a reader of this column, you can help! Please take a moment to call the trade school or two-year college nearest you and ask for the name of the person who teaches a course in radio elec-

Electronics or communications instructor

Name _____

Address _____

MAIL TO: Association of Communications Technicians, NABER, 1501 Duke St., Alexandria, VA 22314.

Help ACT reach its membership drive goal of 500 new members by March 1990. Call your local trade school or two-year college and ask for the name of the instructor who teaches radio electronics, communications or other related courses. Write that individual's name and the name and address of the school on the coupon, clip it and send it to ACT.

tronics, communications or a related subject. Write that individual's name and the name and address of the school on the coupon at the right and send it to ACT.

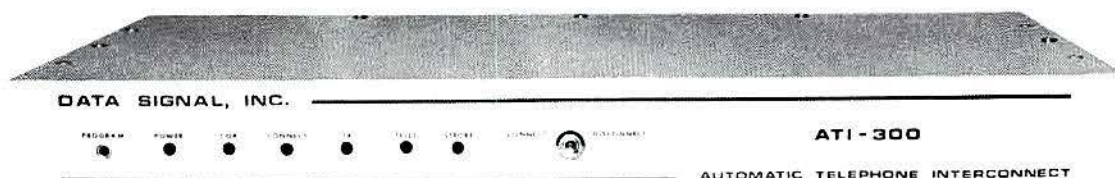
Help your association to reach its

membership drive goal of 500 new members by March 1990.

For information about the association, call NABER at 800-759-0300. Ask for "technician services."



AUTOMATIC TELEPHONE INTERCONNECTS



TWO NEW INTERCONNECTS

ATI-100 \$249-\$369

- Full, Half-Duplex or Simplex operation
- Electronic voice delay
- Desk or Rack Mount version
- */# Connect/Disconnect
- Regenerated Tone or Pulse Dialing
- Direct Voice Dispatching
- Selective Calling (DTMF-DTMF)
- Mobile Activity and Timeout Timer
- Ringout or Auto Answer on 1-4 rings
- Busy Channel Ringout Inhibit
- Transorb Lightning Protection
- Front Panel station LED's
- COS polarity reversal
- 12 VDC powered

ATI-300 \$495-\$595

- All of the Features of the ATI-100, plus:
- Local and remotely programmable via DTMF
- 35 programmable ANI's (Local or remote)
- Verified Global or ANI Access
- Verified Positive Disconnect
- Toll restriction per user (local or remote)
- Two-tone pager
- Control Station capabilities
- DTMF, CTCSS, 2-tone Selective Call
- Mobile-to-mobile Selective Call
- Verified Repeater Access
- CWID-Local or Remote Programmable
- Channel Monitor Capabilities
- DTMF or Rotary Overdialing
- Programmable Voice after Page
- Auxiliary Relay for Channel Control
- Three Programmable Relays for Remote Control
- Busy Signal Disconnect
- Dial Tone Disconnect
- Telco Go-ahead Tone (Programmable)
- Dip Switch Programmable Timing
- Dip Switch Selectable Features
- Simplex Electronic Voice Delay
- Half-Duplex Privacy Modes
- Busy Lockout
- Programmable Secret Access Code
- Unique Station Signalling Tone
- All Features are standard



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Power Supply Products

Powerline Corporation manufactures the most advanced generation of power supply products available.

The *new slimline* design combined with unmatched reliability and affordability sets Powerline ahead of the rest.

Buy it. Install it. Forget it. That's reliability.

Compare the Powerline range of products to the other power products on the market.

Take the covers off and look inside.

You'll see that our equipment utilizes state-of-the-art components.

The others don't even come close whether in or well above our price range.

Special Feature - R12L

The R12L is a new slimline power supply measuring only 2½" high! That means you can put a mobile radio on it without building a mountain of hardware. It is CSA rated at 11amps (12amps surge) and utilizes dual output devices and 105°C capacitors for improved reliability. Over-voltage crowbar circuits and true foldback current limiting are features of the R12L that combine to provide years of trouble-free operation.

The R12L is also available in the same slimline size with an internal speaker (R12L/SP).



The Powerline range

R24L - top-of-the-line 20amp (24 amps surge) slimline power supply (also available in 240v., R24L/240)

RCS 15 - a superb battery back-up supervisory system.

12/12HD - a state-of-the-art polarity conversion device for positive ground vehicles.

24/12HD - the 24v. to 12v. power converter that everyone is talking about.

Circle (50) on Fast Fact Card

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Call or write Ginny at Powerline Corp. for your free colour brochure.

Congressman writes bill to ban pagers from minors

U.S. Rep. Kweisi Mfume (D-MD) has introduced legislation to ban the possession of pagers by persons less than 21 years old. The intent of the "Beeper Abuse Prevention Act of 1989" is to reduce the use of illegal drugs by minors who use pagers to facilitate drug transactions.

FCC approves offset channels for special industrial use

Special industrial radio service licensees have exclusive use of 10 offset channels under rule amendments adopted by the FCC on Jan. 5.

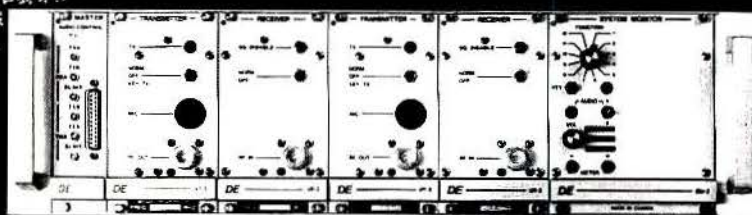
The UHF channels carry an effective radiated power (ERP) limitation of 100W and an antenna height limit of 100 feet. Geographic limitations; minimum

distances between existing base stations on the adjacent channel and the proposed base station on the offset channel; and interservice sharing restrictions apply.

Questions regarding the coordination of UHF 12.5kHz offset channels should be directed to Karin L. Norton, vice president of frequency administration, Special Industrial Radio Service Association, 1700 N. Moore St., Suite 910, Rosslyn, VA 22209; 703-528-5115.

THE PEAK PERFORMER

MT-2 SERIES MOUNTAIN-TOP REPEATER



THE ULTIMATE IN RUGGED AND
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AVAILABLE IN VHF AND UHF
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Commission allows flexibility for mobile channel operation

Common carrier land mobile radio channels, traditionally licensed in frequency pairs for mobile telephone use, may be used for one-way paging systems. The FCC order that established flexible operation for the channels makes it permissible to use one frequency for control functions and the other for paging messages.

New stations 'must protect' San Bernardino offsets

Rights granted to San Bernardino County to use certain frequencies offset by 12.5kHz from 800MHz channels in Southern California must be protected from interference, according to the FCC. At issue are new transmitters that may be added for use at existing sites by current non-public safety licensees. The commission issued the statement in response to a request for clarification of its ruling in the matter submitted by the National Association of Business and Educational Radio.

The regulatory agency instructed the County to use the public safety offset frequencies before resorting to frequencies in non-public safety pools.

Two 900MHz waiver requests are nixed by FCC bureau

The FCC's private radio bureau had rejected two requests for waivers of the commission's rules. Both requests asked for permission to construct 900MHz specialized mobile radio (SMR) base station transmitters outside the Phase I designated filing area.

If This Looks Familiar... Take A Closer Look.



This 16 lb.* Monitor Now Does More—Even Better!

The FM/AM-500A

“Micro-Monitor” from **IFR**

From the beginning, we have always kept with our commitment to offer the highest quality, along with the best value, of any service monitor available. We are sure you will agree that the FM/AM-500A is superior to any low cost monitor on the market today...and most costing thousands of dollars more.

You asked for more features and here they are — **All Standard with the FM/AM-500A:**

- FM Signal Generator
- AM Signal Generator
- Sensitive 2 μ V Receiver for AM, FM and SSB
- ◆ 10 Hz to 9999.9 Hz Audio Generator
- ◆ Audio Frequency Error Meter
- 1 kHz Audio Generator
- ◆ Average and Peak Reading RF Wattmeter (automatically protected generator output to 150 watts)
- ◆ Frequency Error Meter with 1 Hz Resolution
- ◆ FM Deviation Meter to 60 kHz

- % AM Modulation Meter
- ◆ SINAD/Distortion Meter
- 0.5 PPM TCXO
- Audio Demodulator Output
- Microphone Input
- External 10 MHz Reference Input
- Weight: 16 lbs. (7.2 kg) approximately
*22 lbs. with optional battery
- Size: 11.5" wide, 4.9" high, 14.3" deep
(29.2 x 12.4 x 36.3cm)
- Low Price

◆ Added features

Optional Features Include:

- 0.2 PPM TCXO
- 0.05 PPM Hi-Stability Oven Oscillator (Simulcast Paging)
- Internal Rechargeable Battery (Approximately 2 hour Operation)
- High Output Amplifier (+ 30 dB Gain)
- Microphone
- ANT-2 Telescoping Antenna

Features...Performance...and Dependability...the IFR commitment. To see why we say “the best is cost effective”, contact your authorized IFR distributor in your area today for a demonstration.



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TWX 910-741-6952
FAX 316/524-2623

Readers' choice

Of all the new products and services covered in the January 1989 issue of *MRT*, the ones reprinted here generated the most reader requests for additional information. If you missed them the first time, here is your opportunity to acquire more information on them: Just circle the corresponding Fast Fact number on the Fast Fact Card found in the back of this issue and mail the card to us.

Desoldering tips feature angled design

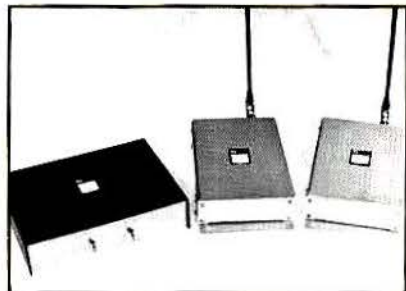


Desoldering tips from **Pace** incorporate an angled design, and the tips can be used with any of the company's solder extractors. A variety of inside and outside diameters are available. Tips come five to a package.

Circle (177) on Fast Fact Card

Radio modems are offered in simplex, duplex

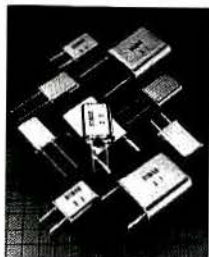
Radio modems from **Solid-State Electronics** used to provide wireless digital communications among personal computers, data terminals, peripherals and other computers are available for simplex and duplex operations as far as 10 miles. Models can be used for pulse code modulation telemetry and remote control.



Circle (175) on Fast Fact Card

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Our pledge to you is simple: we will provide the highest quality product, delivered when you need it. Backed by the best warranty in the industry.

Bomar will support our products with knowledgeable, courteous sales & technical people. At Bomar, the customer is always right!

Circle (53) on Fast Fact Card

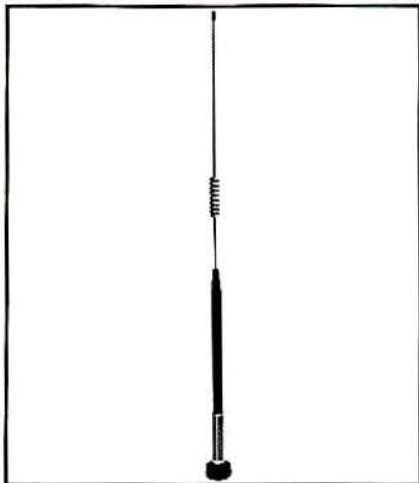
Lightning strike counter tallies current surges



The LSC-2 lightning strike counter from PolyPhaser plugs into a wall outlet and counts surges that exceed $\pm 200V$ with 1 joule of energy. The unit is circuit-breakered and non-resettable and has internal surge protection. It will count as many as 1 million surges.

Circle (176) on Fast Fact Card

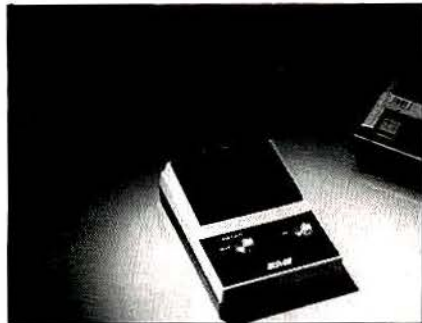
Vehicular cellular antenna designed with steel spring



The PUBC850EF half-wave elevated feed cellular antenna from Valor Enterprises features a stainless-steel spring with Motorola styling and a silver-plated contact.

Circle (433) on Fast Fact Card

Automatic recorder operates with most radios, bases



The Nitelogger automatic recorder from Benjamin Michael Industries connects to the remote speaker of any radio to record radio traffic. An operator can listen to the traffic while recording or the volume control can be turned down for silent operation. The unit operates with most bases, mobiles and portables and comes with cables for connection to standard cassette recorders.

Circle (260) on Fast Fact Card

^{new} "Give Your Competition The ~~Old~~ One-Two!"

You have to be pretty sharp to stay ahead in the two-way repair business. That's why we built the COM-3. It works as hard as you do and for the money, you won't find anything as fast and powerful as the COM-3. In fact, it outperforms units costing over twice as much.

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And now, here's the knock out—introducing the all new Ramsey COM-7 Spectrum Analyzer. The proof is in the picture. High-

performance circuitry provides remarkable sensitivity for superb, high-resolution frequency analysis and observation. Interference location and characterization is easier than ever. Not only can you see the interference, you can hear it too. A variable bandwidth audio demodulator allows you to detect and audibly identify the interfering signals. In addition, a true frequency counter display speeds center frequency setting and reading. Frequency range covers the entire 1 MHz to 1000 MHz spectrum. Add the optional tracking generator and you can easily tune duplexers, filters and cavities!

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RAMSEY
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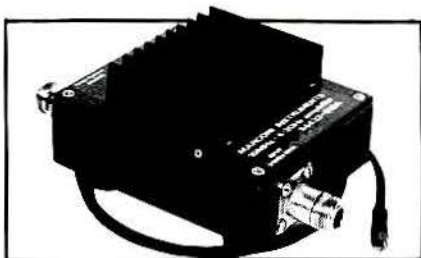


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New products

Amplifier boosts functions of spectrum analyzers



When used with the 2380 series VHF and UHF spectrum analyzers, the Marconi Instruments' 10MHz to 4.2GHz amplifier boosts the input sensitivity and the tracking generator output. With the analyzers, it delivers a 25dB minimum gain.

Circle (445) on Fast Fact Card

Gold replacement whips fit glass-mount antennas



Gold replacement whips are available for Antenna Specialists' cellular glass-mount antenna models APD851.3 and APD852.3. Each whip comes packaged in a reusable storage tube.

Circle (455) on Fast Fact Card

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...ever get the feeling
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| Display | Color | Sort | Call | File | Config | System | |
|--|-------|---------|-----------------------------------|--------|---------|---------|---------|
| Time/Date | | | Attention | | | | |
| 00:14:58 01-01-1900 | | | Emergency:802B | | | | |
| Status/Time | | | | | | | |
| Unit Name | Last | ON DUTY | ENROUTE | # SENE | STANDBY | STATION | Other |
| 0034 CHIEF TRO | 00:08 | | | 00:04 | | 00:05 | |
| 0051 CPT JONES | 00:09 | 00:09 | | | 00:05 | | |
| 0073 MAJ. BARR | 00:09 | | | | 00:07 | | |
| 6306 LT. FRANCO | 00:09 | | | | | 00:07 | |
| 0072 LT. MRES | 00:09 | | 00:05 | | | 00:07 | |
| 0700 SGT. GREEN | 00:08 | 00:05 | | 00:08 | 00:02 | | |
| 0066 SGT. BAKER | 00:09 | | | | 00:09 | | |
| 0056 SGT. POLK | 00:09 | | | | | | |
| 9999 DET. SMITH | 00:07 | 00:03 | | | | | 00:05TH |
| 1010 DET. FORD | 00:07 | | | | 00:07 | 00:04 | |
| 1000 DET. BURNS | 00:09 | | | 00:03 | 00:01 | | |
| 2700 VINCENT | 00:09 | | | | | | 10-50 |
| 6305 WILLIAMS | 00:09 | | 00:02 | | | | |
| 0020 SGT. BENTLEY | 00:09 | 00:02 | 00:07 | 00:05 | 00:06 | 00:06 | |
| 2500 DET. MILES | 00:09 | | | | | | 00:05TH |
| Recent | | | Status | | | | |
| 00:09:44 Demonstration Mode Stopped | | | SU-002B SGT. BENTLEY 02-DETENTION | | | | |
| 00:09:51 802B SGT. BENTLEY Emergency ENROUTE | | | ST 01-ENROUTE C= H=00:00 GC | | | | |
| 00:09:53 Alarm Silenced by Operator | | | AC-00 100 S M G 11 N | | | | |

HIGH-TECH BACKUP WITHOUT A HIGH-TECH PRICE.

An officer in an emergency situation needs help fast. And it's as close as a switch on his radio—if he's using the Bendix/King CONTROLLER™ III radio with computer-aided dispatch.

This powerful dispatch system is surprisingly affordable, yet it has all the capabilities of systems costing two to three times as much.

Most importantly, it allows both officers and dispatchers to work more efficiently. To update his or her status, an officer just keys in a status code on the radio, which immediately shows up on the dispatcher's screen. This information is displayed in an easy-to-read format so the dispatcher can respond quickly.

CONTROLLER III also allows the dispatcher to control the information he or she needs. For example, a dispatcher can selectively call units by group or status, stun or mark lost or stolen radios, and verify a unit's status automatically.

Bendix/King manufactures a complete line of CONTROLLER Series radios. CONTROLLER I offers entry-level voice security, and CONTROLLER II offers intermediate level voice security. CONTROLLER III offers the most advanced level of analog voice security and is available with or without computer-aided dispatch. All CONTROLLER Series radios are available in UHF and VHF portables and in VHF mobiles.

No matter what level of capabilities you need, Bendix/King CONTROLLER Series radios are the right choice.

For more information, contact your local Bendix/King dealer or

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(913) 842-0402 or (800) 523-5955. In Canada, contact
John Eaton, Lenbrook Industries, (416) 831-6333.

Allied-Signal Aerospace Company



Circle (57) on Fast Fact Card

New products

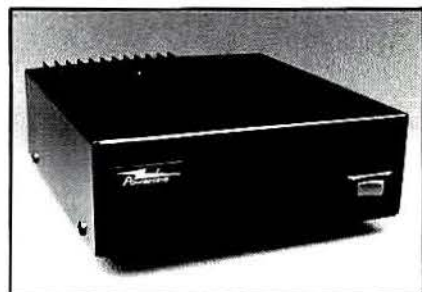
Replacement batteries fit Motorola cellular portables

Replacement batteries for Motorola cellular portable models are available from **W & W Associates**. The batteries fit 6000, 8000 and 9500 series hand-helds. An extended life battery also is available that has twice the capacity of the original battery.

Circle (400) on Fast Fact Card



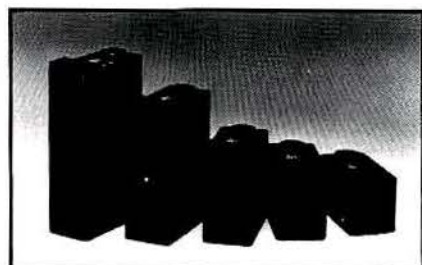
Power supply offers 11A CSA rating



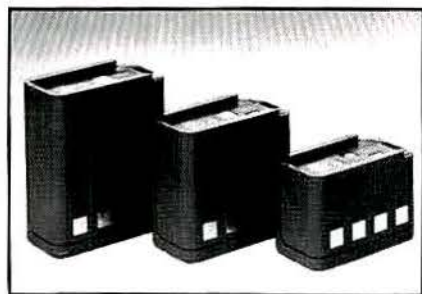
The **Powerline R12L** slimline power supply has an 11A CSA rating and uses dual output devices and long-life capacitors. Features include overvoltage crowbar circuits and true foldback current limiting.

Circle (489) on Fast Fact Card

Replacement batteries fit Motorola MX300, HT600



MX300 replacement batteries



HT600 replacement batteries

Replacement batteries for Motorola MX300 and HT600 radios are available from **Alexander Manufacturing**. For the MX300 series, 12 batteries are available, including eight nicads, three mercury and one alkaline. Seven nicad batteries and one alkaline battery are available for the HT600.

Circle (408) on Fast Fact Card

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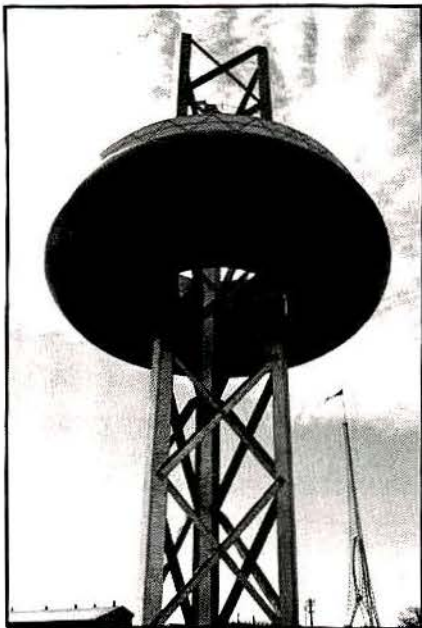
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Three-legged tower resists wind warp



The Landmark three-legged tower fabricated by **Adelphon** incorporates a wide stance among the legs, reducing twist, sway and wind warp. The leg configuration shields transmission lines from falling ice and windloads. The tower is designed around an elevator system in the legs. It supports top-mounted antennas and side-mounted antennas. An optional sky pod can be used to house electronic transmission equipment. The pod has a fiber glass outer shell that allows transmission of radio signals through the outside. An all-weather elevator provides access to the enclosed sky pod. The skypod wraps around the shaft of the guyed tower.

Circle (467) on Fast Fact Card

Backed by Commitment!

Over the years, IDA telephone interconnect equipment has become known for quality design and field reliability around the world. From simplex operations, to the most complex trunking environment, our products deliver customer satisfaction every time.



Model 40-50

From the railroad yards of the People's Republic of China, to the Queen's visit in Canada, the 40-50 computerized voice delay VOX interconnect has proven itself as a leader in today's technology. With features like long distance inhibit, speed dial and last number redial, optional control relays, and FCC registered telephone coupler, just to name a few, we invite you to evaluate it for yourself. Sure you can find interconnects for less money, but none offer the proven reliability that you need for today's mobile environment.



Model 40-15

Introduced in July of last year, the 40-15 half duplex/variable sampling simplex interconnect has already out-sold projections. Why? Because it offers the features you've asked for at a price that's right. And it's been designed with the same commitment to quality and reliability that has made other IDA

products the choice of the industry. This is an interconnect you've got to see to appreciate. Once you have, you'll depend on it time after time.

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Circle (60) on Fast Fact Card

New products

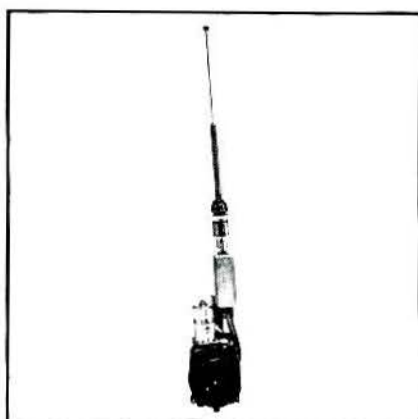
**Tone-and-voice pagers
cover three ranges**



Two-tone tone-and-voice pagers from ICM Communications come in three frequency ranges: RVP-1, 30MHz to 50MHz; RVP-3, 138MHz to 174MHz; and RVP-4, 405MHz to 512MHz. Options include group call, auto reset, ear-phone jack, squelch and monitor functions.

Circle (447) on Fast Fact Card

**Ignition activation powers
cellular antenna mast**



The CX-200 cellular power antenna made by Harada Industry of America features automatic mast extension when a vehicle's ignition is activated and retraction when the ignition is turned off. The antenna comes with five mounting bases with angles from 3° to 30°.

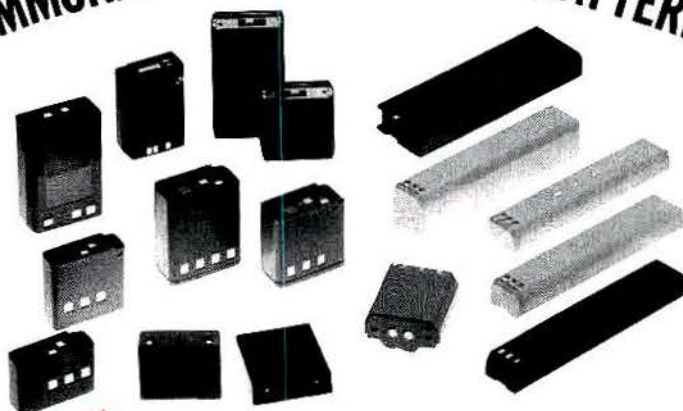
Circle (449) on Fast Fact Card

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Circle (61) on Fast Fact Card

Address decoder is offered for transmitter control panel



An address decoder option is available for the Zetron model 66 transmitter control panel. The decoder option allows individual transmitter deselection on single link, multidrop transmitter networks. The unit uses DIP switch selectable burst-tone decoding techniques.

Circle (461) on Fast Fact Card

Small-system paging terminal includes two trunk inputs

CTI's small-system paging terminal includes two trunk inputs, 16-character liquid crystal display, random programming from a DTMF telephone and mixture of tone and digital formats.

Circle (466) on Fast Fact Card

800MHz repeaters

Uniden makes its model MRS 804 repeaters with two RF assemblies: One has the receiver; the other has the exciter and synthesizer. A screwdriver is the only tool needed to replace the plug-in, modular assemblies.

The 800MHz repeater can be made into a trunked repeater by using the ARX 800A trunking controller circuit board.

Circle (362) on Fast Fact Card

Crimp tool kit handles most connectors, cables

The RFA-4005 crimp tool kit crimps most coaxial connector and cable combinations from RG-58 to RG-214 and Belden cables 9913 and 9914. Available from RF Industries, the kit has interchangeable cast dies that crimp BNC, N, TNC, UHF and mini-UHF connectors.

Circle (490) on Fast Fact Card



HAND-HELD OR MOBILE, VHF OR UHF— MAKE IT A MAXON

With a Maxon, you can expect optimum performance and be surprised by the low price.

HAND-HELD PORTABLES

These 5-watt/4-channel two-way portables are compact* and lightweight, yet built tough enough to perform under rigorous conditions... year after year. Inside, there's advanced micro-circuitry on a durable FR-4 glass epoxy board. On the outside, there's a rugged, heat-resistant Noryl-190® case with a die-cast aluminum control deck, machined aluminum control knobs, and a metal BNC connector. ("HD" models, with a die-cast aluminum "H" frame, meet several criteria of MIL-SPEC 810D and offer an INTRINSICALLY SAFE option for many levels of hazardous conditions.)

Add to this a complete list of available accessories and tone signaling options, and it's easy to see why Maxon portables are preferred around the world.

MOBILES

Maxon's 30-watt/4-channel mobile transceivers, with their rugged steel cabinetry, are only 1 3/4" high*—allowing easier installations, even in smaller vehicles. The faceplate, microphone and optional auxiliary speaker are all made of tough, heat-resistant Noryl-190®. Plus, all controls feature bright LED indicators and are recessed for protection. Inside, solid state switching and advanced broad band strip technology assure you of spectral purity and frequency stability.

There's also a wide array of available accessories and tone signaling options.

That's the Maxon lineup... superior 4-channel radios, built to provide top performance for the long haul... and that's why your next order should read, "Make it a Maxon."



*Patent Des. 292,208

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Communications Associates has been a leader in the wholesale distribution of mobile communications products since our founding in 1979 and today we are one of the largest distributors in the country.

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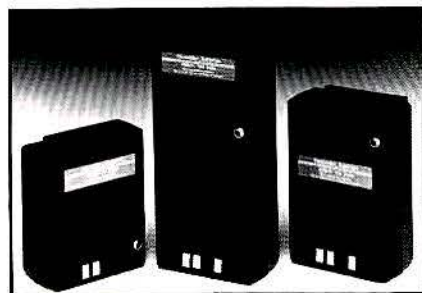
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(815) 744-6444 US (800) 435-9313 IL (800) 892-1611

Circle (63) on Fast Fact Card

New products

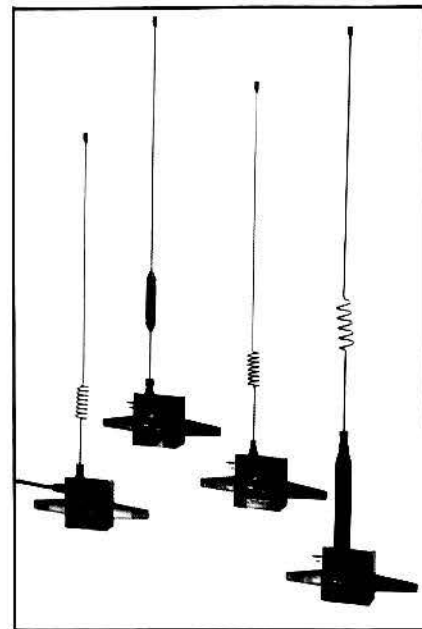
Replacement batteries fit Yaesu FTC2003 radios



Replacement batteries for the Yaesu FTC2003 radio are available from **Alexander Manufacturing**. Model H36210 is a 600mAh, 7.2V battery that replaces the FNB10. Model H36211, a 600mAh, 12V battery, replaces the FNB11. Model H36212 has a 500mAh capacity with 12V and replaces the FNB12.

Circle (320) on Fast Fact Card

Cellular antennas handle 832-channel phones



Four glass-mount cellular antennas from **Ora Electronics** feature ground plane radials and fit 832-channel cellular telephones. The units include a high-gain version, a 3dB unit and a whistle-free unit. The antennas incorporate 180° tilt base, low SWR and wide bandwidth.

Circle (404) on Fast Fact Card

Mobiles features built-in vehicular repeater



A built-in vehicular repeater is the latest feature of **Midland's Syn-Tech II** mobiles. The "portable-mobile" repeater operation is crossband. Model 70-2954 operates in the 450MHz to 470MHz range and installs in lowband, highband and 800MHz Syn-Tech II mobiles for use with UHF portables. Model 70-2953 operates in the 150MHz to 174MHz range and installs in lowband, UHF and 800MHz Syn-Tech II mobiles for use with highband portables.

Circle (446) on Fast Fact Card

Chest pack holds portables, mics



The universal chest pack from **Lone Peak Design** is made of nylon and fits a variety of portables. An adjustable version fits any radio size. The pack has a zippered accessory pouch and an attachment point for mics. It comes in a variety of colors.

Circle (417) on Fast Fact Card

New Ways To Sell Radio. Suggestion #2.

RITRON[®] Telenexus[™] Phone Line Extender



You can provide dependable, low-cost phone service where wireline can't!

The Telenexus from RITRON extends telephone service via a full duplex radio link as far away as 20 miles (line-of-sight) from the terminations of existing wirelines. Now you can give your customers phone service in areas where the phone company can't reach.

The flexibility of Telenexus allows permanent or temporary service at a fixed or mobile location, making it ideal for areas where running a line is cost-prohibitive.

The system provides the user with normal telephone voice quality with no "voice delays." The Telenexus is compatible with DTMF, pulse and rotary exchanges and can be powered by 110 VAC or 12 VDC. Each end of the Telenexus system terminates in standard RJ11 telephone jacks, making installation very simple.

Telenexus' acquisition cost is amazingly low, and since there are no monthly fees, the pay-back period is extremely short.

The Telenexus provides telephone service to:

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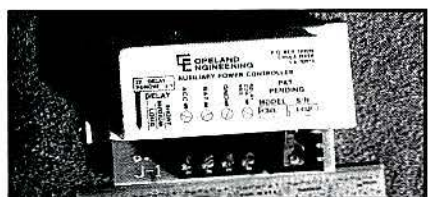
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Circle (64) on Fast Fact Card

New products

Auxiliary controller cuts power after time delay



Circle (451) on Fast Fact Card

The auxiliary power controller offered by **Copeland Engineering** automatically shuts down equipment connected to it when the programmed time delay lapses after a vehicle's ignition is turned off. The delay time can be programmed from 1 hour to 12 hours.

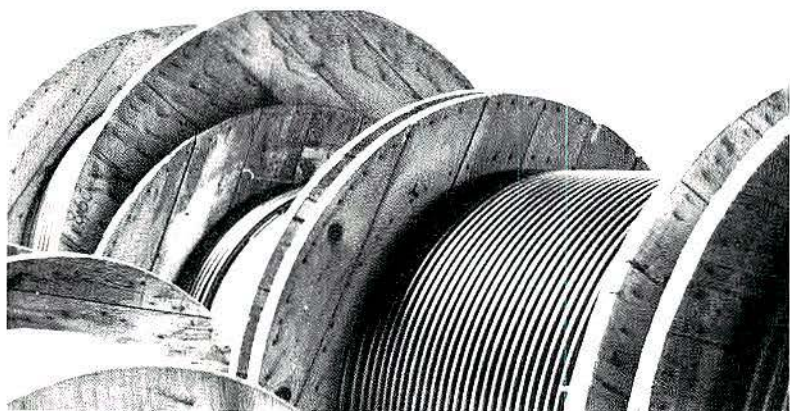
Voice logging recorders offer slow-speed recording



The VLR series of voice logging recorders from **Omnicon Electronics** are available with slow-speed recording that provides 16 hours of talk time per cassette with a separate track for recording continuously repeating oral time and date announcements from the TCC-14 talking clock and calendar. The six recorders in the series feature voice-activated recordings, alarms, single button review of messages and dual 1/4-inch headphone jacks.

Circle (414) on Fast Fact Card

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We're Ready to Roll!



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We've got **ROLLS** and **ROLLS** of Celwave brand cable from LLFLEX 1/2" to the husky 15/8" **IN-STOCK** ready to roll out the door to you. Hutton Communications also has Celwave connectors and professional connector installation available as a low cost optional service. Hutton Communications inventory is centrally located for the most rapid delivery to just about anywhere and our assembled cable and connector prices are hard to beat. Quality Celwave cable, connectors, professional connector installation and great service are all available from HUTTON.

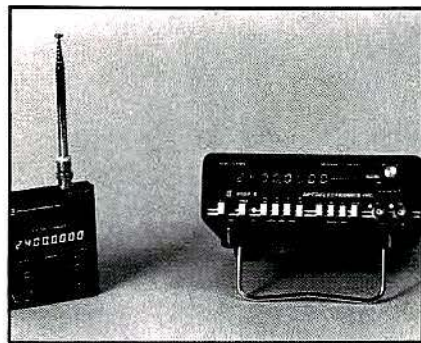
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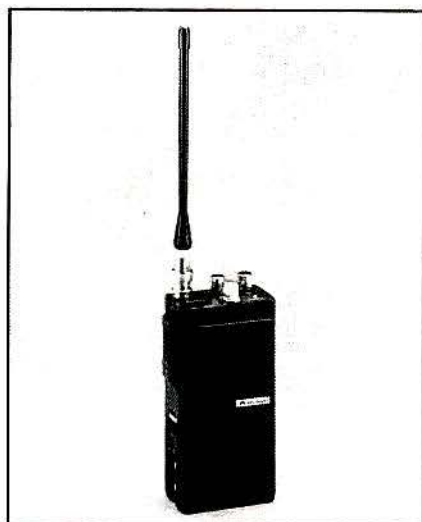
2.4GHz frequency counters are housed in aluminum



Two 2.4GHz frequency counters come in aluminum housings and are available with a full line of probes and antennas. The **Optoelectronics 2400H** is an eight-digit hand-held unit with internal nicad batteries and a range of 10MHz to 2.4GHz. Model 8024-S is a nine-digit bench and portable unit with a range of 10Hz to 2.4GHz.

Circle (457) on Fast Fact Card

UHF portable delivers 5W, tunable to 2W



The 70-243 UHF portable from Midland LMR is compact and rugged and is constructed with a one-piece die-cast chassis and stainless-steel front and back. It offers 5W output, which is tunable to 2W. Four crystal-controlled channels are available. The portable comes with a standard 600mAh battery pack, and a 1,000mAh battery pack is available. Options include CTCSS, external speaker with lapel clip, a back plate with belt clip, carrying cases and battery chargers.

Circle (431) on Fast Fact Card

Isolator options include power fail interrupt



Isolators from Electronic Specialists are available with remote power switching, power fail interrupt and 20A options.

Circle (463) on Fast Fact Card

Paging, mobile interfaces offer voice announcements

Voice announcement options are available on paging, mobile and SMR/DID interfaces from Hark Systems. The option allows the system operator to use custom announcements during call processing.

Circle (259) on Fast Fact Card

Cellular antenna adheres to glass with stick pads

Model PA010 Cellmaster stick-on antenna from Les Wallen mounts with suction cups to any smooth, non-metallic surface. Its power rating is 25W with 120MHz bandwidth.

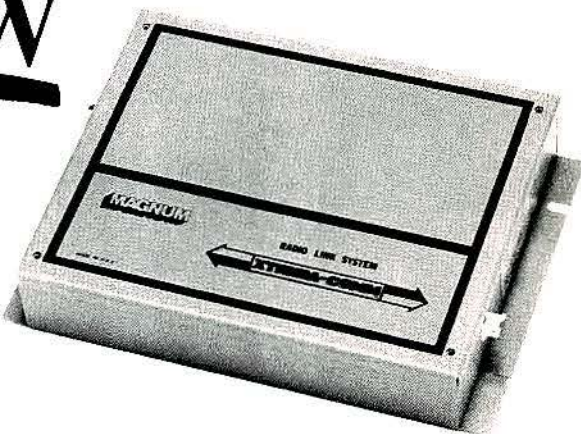
Circle (464) on Fast Fact Card

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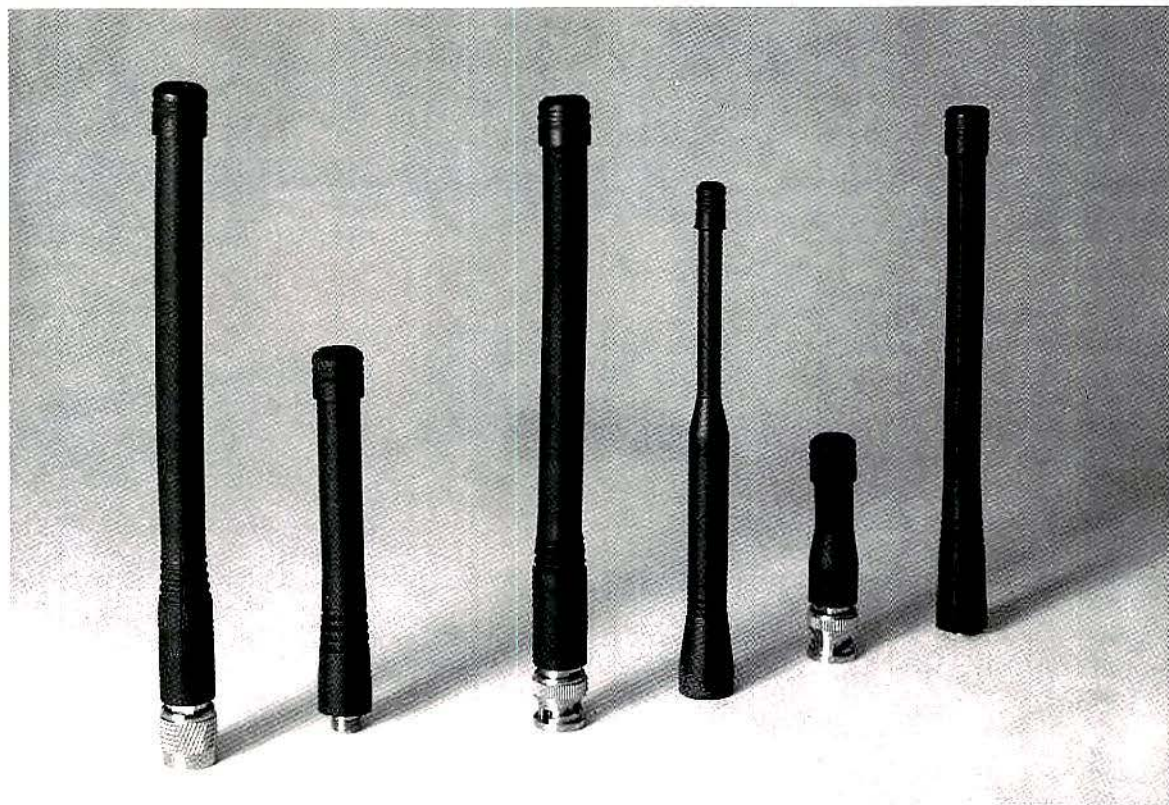
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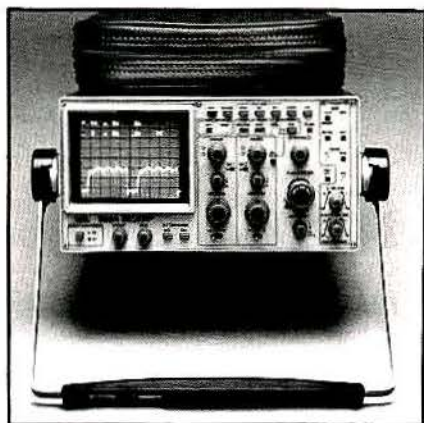
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Circle (67) on Fast Fact Card

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New products

Updated oscilloscope delivers 16 kbytes memory

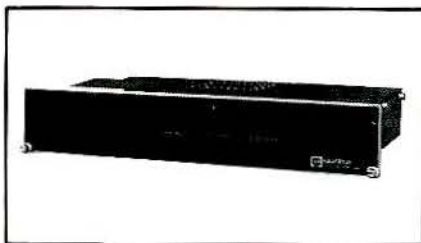


The 336A oscilloscope from Tektronix offers improved performance over the 336. This updated version features vertical resolution to 8 bits, expanded memory to 16 kbytes, automatic setup, eight front-panel setups and the ability to save waveforms. Its sampling rate is 20MS/s.

Circle (301) on Fast Fact Card

Simulcast control system

Five components, a transmitter controller; system controller; receiver controller; monitor receiver; and operator console comprise Quintron's Simul-Comm control system. It provides automatic control and monitoring of simulcast paging or simulcast two-way radio systems.



Circle (343) on Fast Fact Card

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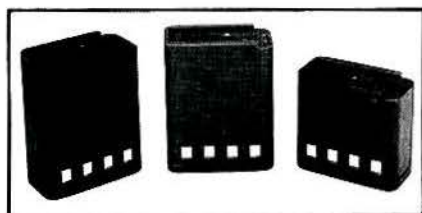
T-Berry

T-Berry Electronics Corporation
15 Technology Drive
Fishers, Indiana 46038
800-648-8683

Circle (70) on Fast Fact Card

New products

Replacement batteries fit Motorola radios



Circle (430) on Fast Fact Card

Replacement batteries for Motorola's HT-600, MT-1000, MTX-800, STX and Radius P-200 are available from **Multiplier Industries**. The M4584 is a 10V, 600mAh battery for use in the HT-600. A standard charger version, the M4563, is available as well. Also available for the HT-600 are the rapid-charge

M5414 1,000mAh and the standard-charge 1,000mAh M5413 batteries.

For use in the MT-1000 and MTX-800 radios, a 10V, 600mAh rapid-charge battery, the M4822, is available, and the standard-charge M4868 is offered. For the same radios in 1,000mAh versions, the rapid charge M5447 and standard charge M4869 are available.

Two 10V, rapid-charge batteries, the M5521 1,000mAh and the M5531 600mAh, fit the Radius P-200 radio.

Replacement batteries for the Motorola STX radio include the M4326 7.5V rapid-charge version with 850mAh and the M4327 7.5V rapid-charge version with 1,250mAh capacity.



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Circle (71) on Fast Fact Card

Signal generator tests microwave deviation

Model 1901 IF and baseband tone generator from **Western Multiplex** performs on-site microwave radio deviation tests.

Circle (448) on Fast Fact Card

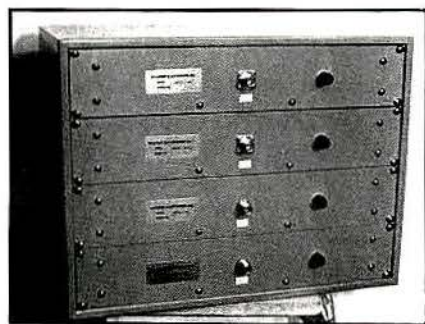
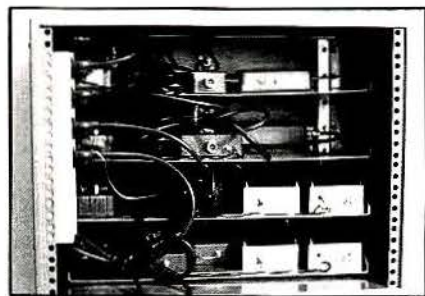
100mW transceivers offer hands-free use



Three versions of hands-free 100mW transceivers are available from **Advanced Videotech**. The Walkphone full-duplex versions include a lightweight headset and adjustable boom mic model, a version with single earmuff and one with double earmuffs. The versions operate as far as ¼ mile apart between two users.

Circle (441) on Fast Fact Card

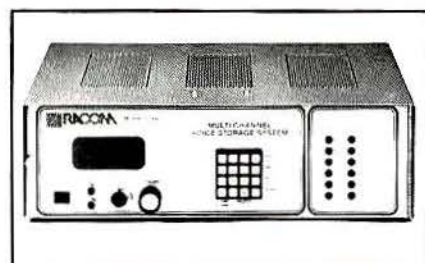
Receiver multicoupler comes with lightning protection



A wideband receiver multicoupler system from **Wi-Comm** operates at 5kHz to 900MHz and includes four models: 5kHz to 2MHz, 2MHz to 30MHz, 30MHz to 200MHz and 200MHz to 900MHz. Low-pass and high-pass filters are available. Separate 115Vac supplies power to each multicoupler. Each supply is protected by a fuse block on the front panel. Lightning protection is included in each amplifier.

Circle (423) on Fast Fact Card

Voice announcer boasts a 64-message capacity



Model 1700X-SP36 multichannel voice announcer from **Racom** records as many as 64 messages. The system features six audio channels that function simultaneously or separately.

Circle (452) on Fast Fact Card

Mobile data system fits SMR dispatch uses

The Digicom Digital Dispatcher D3 manufactured by **ElectroCom Automation** can be configured to meet the needs of an SMR operator. The mobile data system provides real-time ordering, tracking, status monitoring and data management.

Circle (454) on Fast Fact Card

Controller has 20 outputs

The Plectron station controller made by **Woodson Electronics** uses micro-processor control. A keyboard enters data to program the unit in the field. The unit controls as many as 20 outputs and retains programmed data during power outages.

Circle (372) on Fast Fact Card

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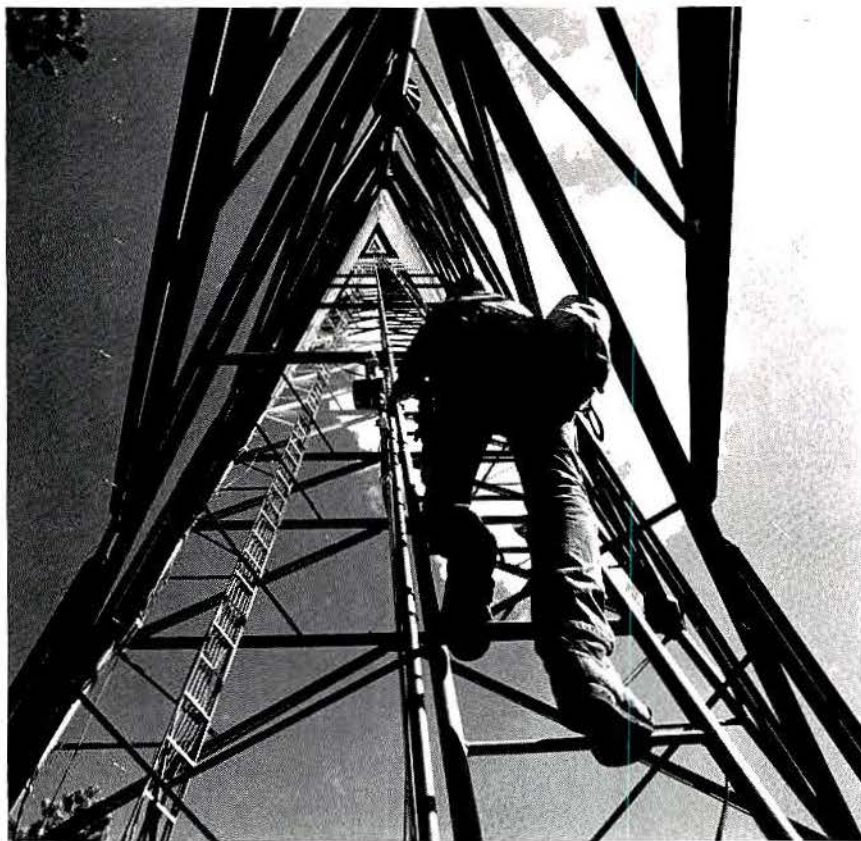
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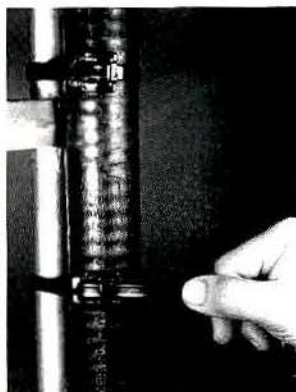
Circle (72) on Fast Fact Card



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Circle (73) on Fast Fact Card

New products

Solar-powered repeaters

MT 2 series mountaintop repeaters made by **Daniels Electronics** work in sites characterized by extreme cold, icing and strong winds during winter; high ambient temperatures during summer; lightning-induced electrical transients; and wide voltage fluctuations during variable solar charge conditions. Repeaters are available for VHF and UHF bands.

Circle (294) on Fast Fact Card

IMTS decoder board mounts in Midland 340, 342XL units

The IMTS-2 decoder board fits in Midland 340 and 342XL mobiles. Made by **Pacific Circuit Design**, it enables IMTS, private channel, RCC and community repeater operation. It mounts in the option space on the Midland radios.

Circle (460) on Fast Fact Card

Mobile phones enable dispatch, interconnect



Trunked dispatch and telephone interconnect service is within reach with **Motorola's** Privacy Plus 250 and 750 mobile radios. The units provide access to the public telephone system and two-way dispatch calls. The multiple system select on the radiotelephones allows users to place and receive telephone calls on 15 SMR systems over extended geographical areas. The Privacy Plus 750 can be programmed to operate on 20 trunked channels. On- and off-hook dialing, 10-memory dialing and an external alarm are included on the units.

Circle (406) on Fast Fact Card

Save



When a life lies in the balance, you need the best. You need the Call Check digital message repeater from Dictaphone.

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uninterruptable power supply to protect against losses of power for

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As you'd expect, Call Check instantly replays telephone messages. But it also does so without interrupting recording of incoming calls. Meaning messages, and hopefully lives, will never be lost.

When you can't afford to take chances, the choice is very simple: the Call Check digital message repeater from Dictaphone. To find out more, mail in the coupon, fax to 1-203-381-7100 or call 1-800-433-0880. It could help you save much more than messages.

And because messages are recorded digitally, you can locate them for immediate playback. Instantly. The unique *Save* feature also allows you to hold on to a message for playback later.

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What's more, Call Check is the only message repeater that visually displays the messages you receive, as well as the times you receive them.

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Circle (74) on Fast Fact Card

Commonwealth Speaks Your Language

If you don't get the message, you won't get the business—so commonwealth has eliminated language barriers.

Commonwealth Communications is introducing its multilingual voice prompts for your MARK digital paging terminals. Now you can select caller prompts in sets of any four different languages.

Of course, Commonwealth quality is built into this new feature. Our Adaptive Delta Pulse Code Modulation method of recording and playing back voice prompts results in realistic, pleasant and highly audible speech.

If you would like to hear one of our multilingual voice prompts, dial (804) 798-9151. Dial format numbers 1-5 for English prompts, and enter numbers 6-0 for the same prompts in Spanish.

Remember, Commonwealth has been in business longer than any computerized paging terminal manufacturer in the nation. And we're proud to say we're still operated by our founders.

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Circle (107) on Fast Fact Card

DOC Approved

Thank you

Merci

DANKE

Gracias

New products

Portable tower goes up fast



The RapUp non-telescoping portable tower manufactured by **Rapid Deployment Towers** carries a substantial payload. Three bands of steel unroll and form together to make a triangular mast. Guy winches under computer control regulate guy wire length as the tower rises straight to its uppermost vertical position.

Circle (351) on Fast Fact Card

Mobile display decoder

Model 3004 display decoder from **Bramco** provides a one- to four-digit backlit LCD. It may be programmed for input range, number of digits, timing, beeper, alarm and digit counting. The unit operates on 12Vdc and may be used as a desktop unit with a separate wall-mount power pack.

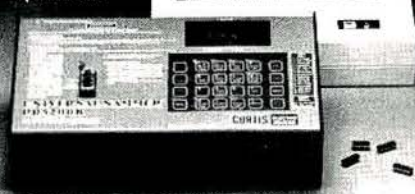


Circle (364) on Fast Fact Card

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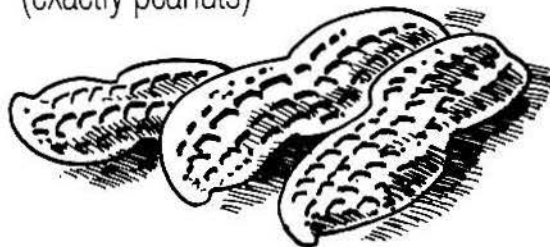
10



Circle (77) on Fast Fact Card

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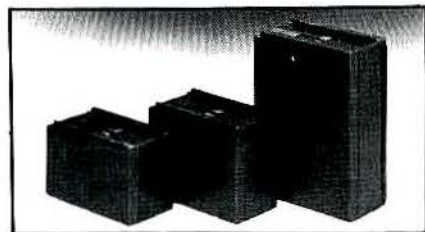
State of the Art Antennas

Quality-Made in the U.S.A.

Circle (105) on Fast Fact Card

New products

Replacement batteries fit Midland portables



Alexander Batteries makes replacement batteries for Midland LMR Syn-Tech 70-155 portables:

- Model R7017 7.5V 500mAh replaces Midland model 70-B17.
- Model R7018 7.5V 900mAh replaces Midland model 70-B18.
- Model R7019 7.5V 1.3Ah replaces Midland model 70-B19.

The battery construction features an ultrasonic seal applied from the bottom, instead of the side. The technique used helps to prevent the packs from breaking if they are dropped.

Circle (334) on Fast Fact Card

You Liked the PK-80? You'll Love the PK-90!

- Data rates from 1200 baud, dependent on channel bandwidth
- Easy datalink trouble shooting with remote control of PK-90 by radio
- Password access ensures system security
- SMR operation with trunked radio interface
- Built-in data encryption for security-sensitive applications
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- Host computer control language
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- Easy connection to your computer and radio
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The PK-90 replaces the PK-80 Packet Radio Controller and brings you the above features NEW TO PACKET. Applications range from remoting a computer terminal through a radio link to control of distant equipment using the PK-90 with inexpensive SCADA controllers. You can coexist on a simplex channel with other voice or data users. Data is error-free, and the untrained user can learn station operation quickly. A station can cost less than \$1000. JUST CALL AND ASK!!

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Circle (80) on Fast Fact Card

Control module displays ID



Positron's "intelligent control module" uses an LCD to display automatic number identification information. The module works with the company's dispatching center equipment to facilitate taking calls by simplifying call managing and call transferring.

Circle (376) on Fast Fact Card

Voice and data system service covers the nation

The CoveragePlus voice and data mobile system meets trucking industry requirements for nationwide communication. The system uses Motorola's trunked two-way radio technology and a network of specialized mobile radio (SMR) systems.

Circle (366) on Fast Fact Card

5W portable output is switches to 1W RF output

The series 2000 5W, six-channel portable from Advanced Videotech offers switchable power output of 1W. The radio has a die-cast steel frame and low-battery indicator. The radio comes with a 6-inch rubber duck antenna, a belt clip and crystals for one VHF channel.

Circle (440) on Fast Fact Card

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Circle (81) on Fast Fact Card

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- 9 PROGRAMMABLE STATUS MESSAGES
- 4 PROGRAMMABLE "CANNED" MESSAGES
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- RECEIVE 256 CHARACTER TEXT FROM BASE
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Circle (82) on Fast Fact Card

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Circle (83) on Fast Fact Card

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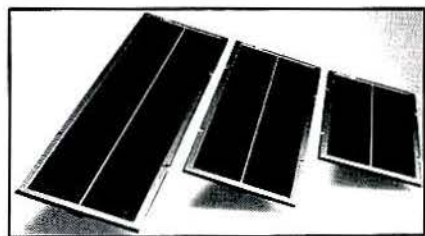
Mobile & Fixed Cellular Telephony 1215 Washington Ave. Wilmette, IL. 60091

312/256-8000

Circle (84) on Fast Fact Card

New products

Photovoltaic modules



Atlantic Solar Products offers Arco Solar G-series solar electric power modules in seven power ratings from 5W to 25W. Reaction injected molding and special polymers used during assembly improve the thin-film solar module's durability.

Circle (356) on Fast Fact Card

Cellular hand-held permits access to 2 phone numbers



Panasonic's EB-KJ3500 compact cellular hand-held features a dual selectable telephone number function that allows a user to subscribe to two cellular phone numbers. The unit has a rechargeable battery that enables 12 hours standby and as much as 70 minutes of continuous talk. Features include a backlit keypad, a large 30-character LCD, 832-channels, signal-strength indicator, on- and off-hook dialing, low-battery warning, resettable total timer, individual call timer and scratchpad dialing. The unit has a stay-alive function that holds the connection while changing the battery within five seconds. The phone weighs 19 ounces.

Circle (453) on Fast Fact Card

NEW Advanced Bird Model 43P Wattmeter



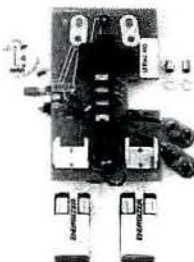
MEASURES PEAK POWER OF SSB AND OTHER AM SIGNALS

The new Bird Model 43P Wattmeter — similar to our standard Model 43 Wattmeter — has the added capability of measuring audio peak power of single sideband and other AM modulated signals.

The Model 43P includes a peak measuring circuit board which mounts into the back of the Model 43 housing, enabling you to measure peak power to

an 8% F.S. accuracy, without affecting cw operation or accuracy. (Owners of the standard Model 43 can modify their own units with retrofit kit Model 4300-400.)

Contact your Bird distributor or the factory for details.



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621 Ojai Ave., Suite F, P.O. Box 28 Ojai, CA 93023 805-646-7255

Circle (85) on Fast Fact Card

Mobile RF amplifiers

Smart Amp RF amplifiers are protected against accidental RF overdrive, high VSWR and thermal overload. If an amplifier should shut down for any of these faults, three LED status indicators show which condition is the cause. Made by Shure Brothers, the amplifiers are available in various frequency ranges and power ratings.

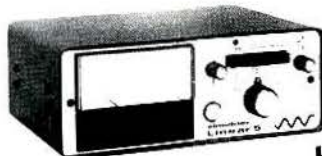


Circle (378) on Fast Fact Card

Midland LMR's model 70-0500 CWB Syn-Tech II lowband VHF mobile covers 37MHz to 48MHz at rated specifications without retuning. Within the 11MHz segment, the radio can be programmed for as many as 320 channels organized in as many as 16 channel groups. RF output is adjustable from 25W to 50W. A dual high-low power option provides 25W-to-50W and 1W-to-10W ranges that may be selected from the control panel or programmed by channel.

Circle (369) on Fast Fact Card

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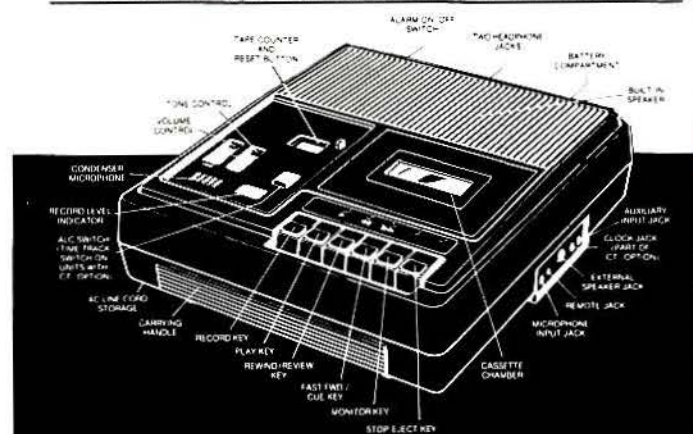
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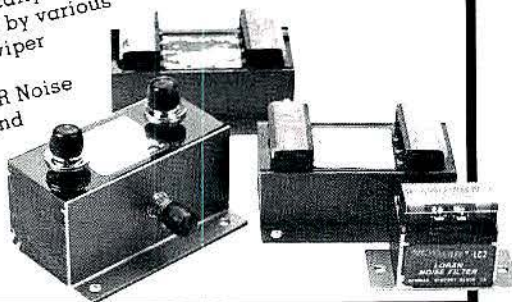
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New products

Replacement batteries fit Standard HX400 radio

Two replacement batteries from **Alexander Manufacturing** fit Standard's HX400 radio. Model H26240 replaces Standard CNB40 and is a 500mAh, 12.5V battery. Model H26241 replaces Standard CNB41 and is a 900mAh, 12V battery.

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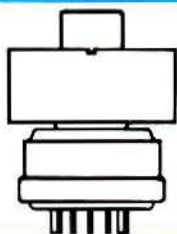
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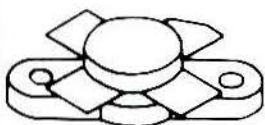
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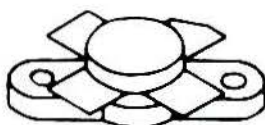
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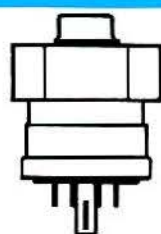
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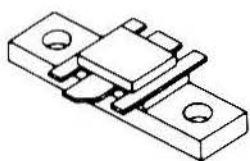
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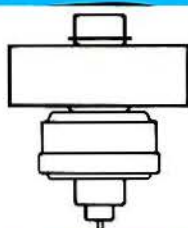
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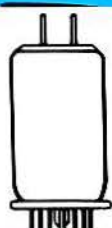
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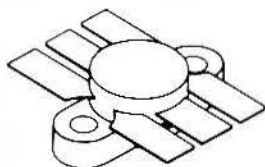
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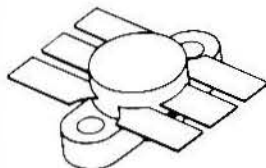
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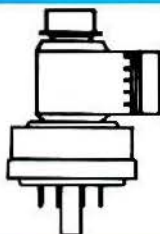
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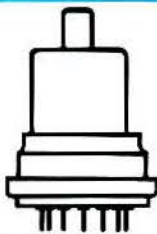
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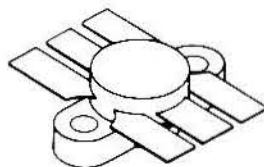
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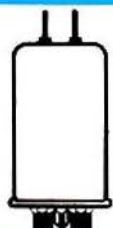
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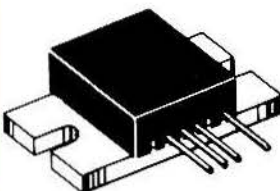
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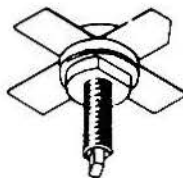
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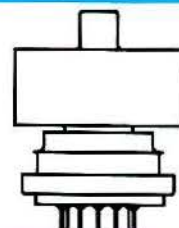
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PHILIPS

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Part 90 FCC regulations offers up-to-date data

"FCC Rules and Regulations: Part 90" is available from the **National Association of Business and Educational Radio**. The rules edition offers information current as of Feb. 15, 1989, and it contains rules for all private land mobile radio services. Names, addresses and telephone numbers of FCC-certified frequency-coordinating committees are listed in the reference, as well as FCC district field offices. Discounts are available on orders exceeding 10 copies.

Circle (475) on Fast Fact Card

Report covers cellular market

A study of the cellular market to 1997 is available from **Technology Futures**. The study examines improvements and implementation of digital technology and total monthly cost of cellular service.

Circle (324) on Fast Fact Card

Equipment catalog covers cable, towers, radio systems

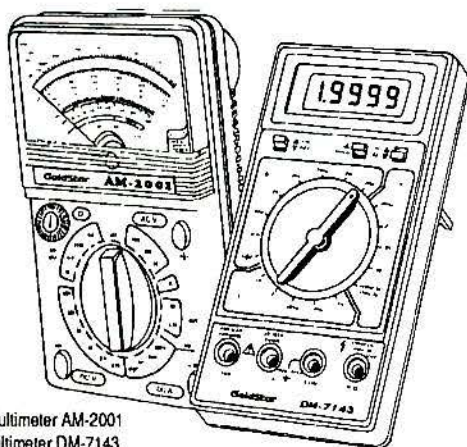
Andrew's catalog 34 serves as a systems planning guide, a product selection and specification guide, and a technical source for various product applications. The 488-page publication includes land mobile radio and cellular telephone systems; microwave; coaxial cable; towers; equipment shelters; satellite communication; and other communications-related equipment.

Circle (426) on Fast Fact Card

Cellular retail report shows price declines

"The Retail Market of Cellular Telephones" shows cellular telephone prices for June 1988 continue to drop. Portable sales continue to rise, according to the survey from **Herschel Shostek Associates**. Other statistics are included in the report, such as the current owners of cellular telephone are prime purchasers of portables.

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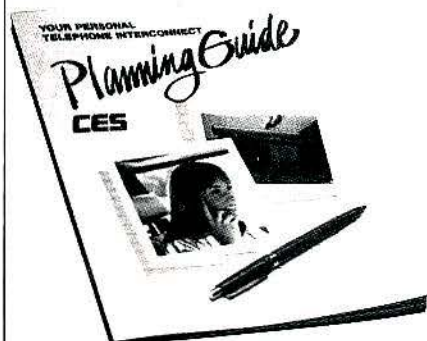
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Good service is essential to compete with retail

Consolidation continues to affect the mobile radio industry, and some analysts speculate it will govern shifts in product distribution. Ahead for mobile radio is retail distribution, according to predictions. "I think retail sales is the evolution of our industry. We don't have to sell product ourselves to be profitable. Let retail people sell it for us. I don't think we can afford armies of salespeople in the '90s," commented Mark Dunaway, owner of a consulting company in Atlanta, at a trade show.

Will retail sales of mobile radios affect most operations? According to the majority of readers responding to the January "What Do You Think?" questionnaire, the answer is it will have some sort of impact. The effect is reported in these statistics:

| TYPE OF EFFECT | % |
|----------------|-------|
| Big impact | 37.1% |
| Some impact | 34.8% |

Little impact 12.4%

No impact 14.6%

No answer 1%

Cellular mobile telephone sales from inception have been a retail item and have penetrated the marketplace at various retail outlets. But for other land mobile products, two-way dealers have

Retail advantages

- Market awareness.
- Increase volume of sales.
- Lower customer prices.
- More users.

served as major distribution centers. For these dealers, the onset of retail distribution could be damaging; for others, it could lead to a broader use of services and market growth, readers report.

Readers are divided on whether retail

distribution will force out dealers; 44.9% say yes, and 46.1% say no. "Look at Ritron's Jobcom and Motorola's Radius. These units are sold by a lot of retailers. The units sell to the public cheaper than I can buy them. One customer asked why he could buy a radio for \$295 (5W, two channels) when my (better) radio was \$565," comments a dealer.

Service is key

Despite the advantages of volume-buying discounts afforded to retail outlets, dealers lament that good service is vital to traditional two-way distribution survival. "Retail will not be able to offer the full service of a dealer," a reader comments. Offers another: "Retail outlets won't have the service or follow-up sales contact that our shop will and does provide."

"Full service, turnkey dealers will always be needed—witness the mighty IBM in the computer room," adds a

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dealer. "The impact on established two-way dealers will not even effect their operations," echoes a dealer.

"Those dealers who are 90% sales and 10% service will be severely hurt; the 90% service dealers won't," agrees a dealer and service shop owner.

Besides the advantage of service capability, dealers point out other differences that will enable them to survive and compete. "Low-end product would become more disposable. We would market mainly middle to high end products," a reader remarks. "Two-way radio is specialized. Dealers have this special knowledge," adds an engineer.

"Consumers are not ready for mail-in service. Retailers are not willing to educate themselves in the business," adds a sales and service shop vice president.

Price compromises

Dealers contend that small operations will have problems competing, especially with price concessions. "Dealers unable to compete pricewise or

whatever will be gone," comments a technician. Notes a service manager, "Trying to compete with large quantity discounts forces the smaller dealers to drop product lines because we cannot compete pricewise."

"Dealers, especially the smaller ones, will not be able to compete because of buying power," stresses a dealer. "Most dealers cannot afford to buy great quantities of product to compete with prices," concurs another dealer.

Surmises a technician: "Why pay a dealer a 'fair' price for products and services when you can get a 'blue light' special?"

Although many dealers believe the small operation could suffer with retail distribution, others perceive the move to retail outlets as healthy. "[Retail] probably will force some dealers out, but it should cultivate the field causing gains for others as well," comments a dealer. "Look at how much interest cellular spurred in SMR," adds a manufacturers representative.

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Feedback

more sales," responds a technician. Adds another technician: "When Wal-Mart sells two-way, people who have never noticed two-way will see it."

"More potential users will be exposed to the professional quality land mobile product," notes a technician. "It (retail) will increase sales through awareness, not just 'retail sales,'" adds a technician. "Manufacturers will suddenly spend big ad dollars to support the 'K-Mart-type' buy," suggests a dealer.

Costs of retail

Readers believe there could be detrimental costs associated with retail distribution. "Retail will spur market awareness but will cause and cost the manufacturers their reputation," notes a dealer. "Large retailers do not have the technical expertise to design systems or talk logically about land mobile products. Without experienced sales personnel, they could do more damage than good," explains a communications service manager.

A consultant adds, "I feel it has the

potential to turn business radio into another citizens band." Echoes a dealer. "It will simply put products into un-

Retail disadvantages

- Forces out smaller dealers.
- Possible illegal operation.
- Lack of technical expertise and support.
- No specialized service, after sales aid.
- Less professional manner.

qualified people's hands and thus ruin manufacturers' reputations."

Others do not see the need for retail sales. "Two-way radio is a professional product and those persons inclined to retail buying are not a part of this market," says a dealer. Adds another, "Those who need mobile radios are more than aware of its existence." "Those who need communications *are* aware; those who do not need it won't

buy much," adds a dealer.

Spectrum overload?

Readers cite unauthorized and overcrowded spectrum uses as potential problems with retail distribution. "Retail will spur sales of equipment by big retailers. From what Regency, Ritron and Radius are doing, I hope that the FCC will be ready to handle the problems that are certain to come," states a dealer.

"As long as restraint is used in selling product to licensed operators only and programming is limited to authorized users only, I don't see much of a problem," explains a public safety coordinator.

A communications specialist adds: "The last defense against the FCC deregulation is the honest, knowledgeable and reputable dealer. There is the possibility of increased unauthorized uses on public safety channels and of increased deliberate jamming of channels."

"Dealers tend to regulate use of



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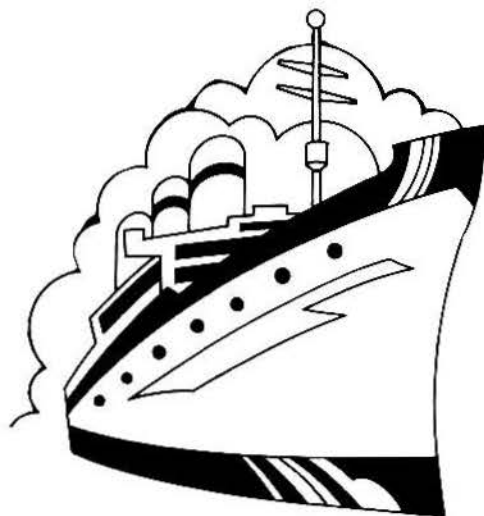
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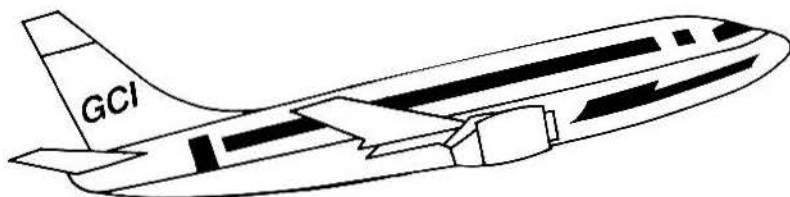


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Feedback

unauthorized channels. We anticipate many more unauthorized users," echoes a communications officer. "Who will license all these radios? Will there be any control?" asks a dealer. "The misuse of spectrum is already a serious problem in the major market areas," echoes a dealer.

"With all of the frequency congestion and unlicensed use today, this will only

make it worse," surmises a land mobile service manager. "I think they will saturate the uncoordinated frequencies," adds a dealer.

Some dealers will not look favorably upon manufacturers who resort to retail distribution. "It could give the manufacturers a poor name if support services are not available after the sale by a small outlet," says a dealer.

"It will hurt their credibility because the retail store cannot give service after the sale," adds a service manager.

"How would a car dealer like Sears selling Cadillacs?" retorts a dealer. "I think it is going to create problems for them, and I look toward capitalizing on their shortcomings," adds a dealer.

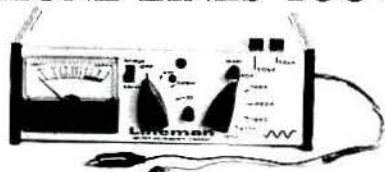
"I am against it. Why make service and sales organizations at small local dealers compete with retail chain stores?" responds a technician. "It should not be done if it will harm the dealers who in the final analysis will stand behind the product and also recommend or not support it," concurs another technician.

On the positive side, comments include: "It is an excellent way to sell more low-end product." "It is a logical step to lower prices and to increase volume." "It is inevitable."

Surmising dealers reaction to retail distribution, a dealer says: "Retail outlets are the biggest and worst competitors. They not only cut prices but offer no service."



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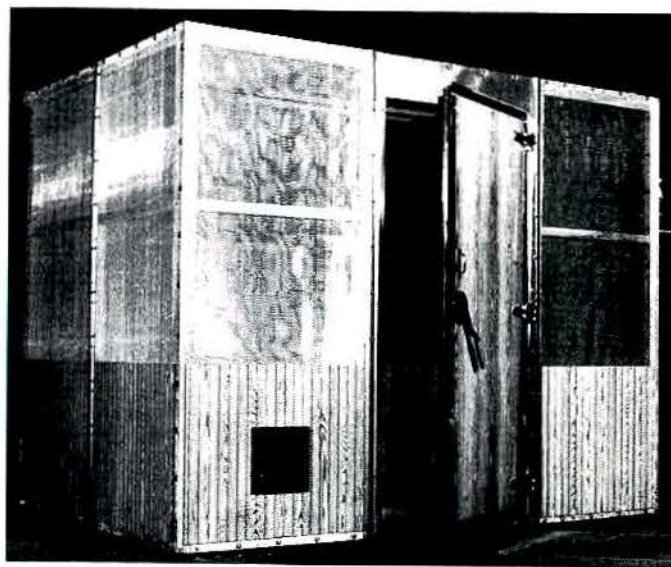
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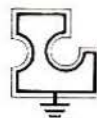
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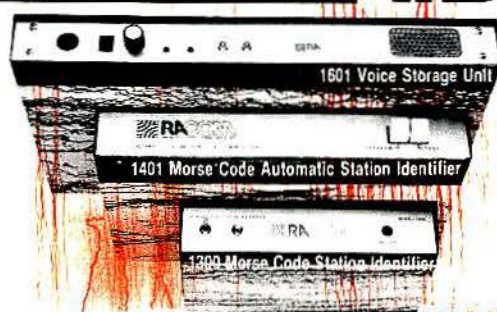
Scott Henderson, vice president of sales for Midland LMR, Kansas City, MO, joins the board of advisers for the International Mobile Communications Expo and Expo/East shows.

Glenayre Electronics' acquisition of the Canadian and U.S.A. operations of Multitone PLC, U.K., creates new assignments and responsibilities for several former Multitone executives and managers in Springfield, NJ. Multitone U.S.A. was based in Springfield, which now is the headquarters of Glenayre Electronics U.S.A.

Multitone U.S.A. president **David G. Mazzella Jr.** becomes vice president of sales at Glenayre U.S.A.

A Multitone U.S.A. national sales manager, **Kathleen "Kate" Gibbons**, becomes Glenayre U.S.A. sales manager

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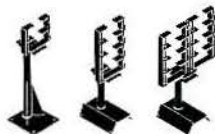


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People

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John Badrick becomes U.S. sales manager for Glenayre's Multitone and Ferritronics products.

Two new managers join the company:

Hoie Meinzer, BBL Industries' western area sales manager, leaves BBL, Atlanta, to join Glenayre U.S.A. as U.S. national accounts manager.

Lowell Hardison exits BBL as a sales rep for seven western states to fill the southwestern regional sales manager post with Glenayre U.S.A.

Richard Chocolate advances from manager of system engineering to international sales manager for Celwave, Middletown, NJ.

Appointments at Celltronics, San Diego:

Customer service manager **Barry Canter** advances to assistant sales manager for the Neutec, Neulink and Trilec-tric divisions.

Production technician **Roberta Reik** advances to customer service manager for the same divisions.

Major accounts executive **Bruce Wallace** moves up to national sales manager.

Jennifer James joins Celltronics as international sales coordinator, leaving an international public relations position with another company.



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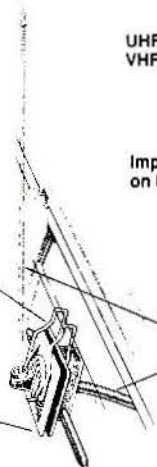
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6-10—Associated Public-Safety Communications Officers 55th Annual National Conference, John Ascuaga's Nugget, Sparks, NV. Contact: 800-824-1850.

27-30—International Association of Fire Chiefs Annual Meeting, Indianapolis Convention Center, Indianapolis. Contact: 202-833-3420.

September

7-9—Land Mobile Expo/East, Orange County Convention Center/Civic Center, Orlando, FL. Contact: 303-220-0600.

October

4-7—Telocator 41st Annual Convention and Exposition, Washington Convention Center, Washington, DC. Contact: 202-467-4781.

14-19—International Association of Chiefs of Police Annual Meeting, Commonwealth Convention Center, Louisville, KY. Contact: 301-948-0922.

16-17—American SMR Network Association Fall Meeting, Ritz Carlton Hotel, Rancho Mirage, CA. Contact: 202-331-7773.



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| 16 T45VBJ SYNTOR 35W 32F | \$ 725 |
| 14 T45RTA MICOR 35W 5F | 475 |
| 6 L35WLB MOTRAC 20 CHANNEL TRUNKED | 250 |

UHF 450-512 mhz.

U1 = 408-420 U3 = 450-470 U4 = 470-494

U5 = 494-512 U4A = 450-512

| | |
|--|-------|
| 11 T74JJA MITREK 100W 4F | \$525 |
| 6 T44JJA MITREK 60W 4F U4A | 395 |
| 3 T34JJA MITREK 25W 4F U4A | 295 |
| 9 T44RTA MICOR 50W 4F U3 | 195 |
| 16 T34RTA MICOR 25W 4F W/SPACED U3 | 199 |
| 11 T44BBA MOCOM 70 75W 4F U3 | 425 |
| 6 T44BBA MOCOM 70 50W 4F U3 | 255 |
| 12 T44BBN MOCOM 70 25W 4F U3 | 195 |
| 5 T-1400 MOTRAC 90 W IMTS BASE/RPR | 799 |
| 10 T-1838 PULSAR II UHF IMTS MBL PHONE | 895 |
| 6 T-1839 PULSAR II UHF IMTS NO ACCY'S | 195 |
| 12 T-1840 PULSAR II UHF IMTS NO ACCY'S | 195 |

VHF 150-174 mhz.

V2 = 150-162mhz V2A = 150-174mhz

| | |
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| 9 L73JJB MITREK 110W* #SUPER CNSLT/TC | \$995 |
| 3 T83JJA MITREK 110W* #MOBILE 4F V2A | 695 |
| 1 T53JJA MITREK 60W* #MOBILE 4F V2A | 575 |
| 1 T43JJA MITREK 45W* #MOBILE 4F V2A | 495 |
| 1 T83RTA MICOR 100W* #MOBILE 4F V2 | 650 |

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T73RTN MICOR 100W* #MOBILE 4F V2 ... \$299

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| 9 T53RTN MICOR 60W* #MOBILE 4F V2 | 500 |
| 19 T53BBA MOCOM 70 60W* MOBILE 1F/4F V2 | 425 |
| 8 T43BBN MOCOM 70 45W* MOBILE 1F/4F V2 | 375 |
| 29 U33BBN MOCOM 70 30W* MOBILE 1F/4F V2 | 250 |

CHARGERS

| | |
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| NLN-4566 MT/HT OMNI RAPID MULTI-UNIT | \$100 |
| NLN-5593 HT210 OMNI STANDARD (220V AC) | 25 |
| NLN-6480 PT-400/500 MULTI UNIT CHARGER | 25 |
| NLN-6684/NLN 4557 HT/MT SLIM STANDARD | 25 |
| NLN-6804/NLN4561 HT/MT OMNI STANDARD | 25 |
| NLN-6895/NLN-4565 HT-MT SLIM RAPID | 75 |
| NLN-8005 HANDICOM MH10/70 STANDARD | 25 |
| NLN-8004 HANDICOM MH10/70 RAPID | 55 |
| NLN-8858 MX SERIES RAPID | 95 |
| NLN8890 MX SERIES 14-HR RATE | 55 |

BATTERIES

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|-------------------------------------|------------|
| 60-5102E05 MX NLN-5860 1200ma | NEW! \$ 50 |
| 60-5928J02 HT90 NLN-7434 RAPID RATE | NEW! 55 |
| 60-84642H01 NLN-6761B OMNI STANDARD | NEW! 22 |

MOBILE CHARGERS

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| NTN-4266 HT90/440 MOBILE CHARGER | \$ 75 |
| NTN-4267 AUDIO CONTROL HEAD OPTION | 45 |
| N-1244 MX SERIES CONVERT ACOM/no vol ont | 55 |
| N-1248 MT 500 SERIES CONVERT ACOM | 75 |
| HSN-6027 CONVERT ACOM 12 W | |
| POWER SEAKER | 30 |
| N-1340 MX SERIES CONVERT ACOM | 75 |
| N-1353 STX SERIES CONVERT ACOM | 95 |

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| HMN-1000 TRAXAR (new style) w/FLAT CORD | \$ 45 |
| HMN-1018 MITREK w/DTMF PAD | 125 |
| HMN-6055 HANDICOM REMOTE | |
| MIKE W/VELCRO | 45 |
| HMN-6059 HANDICOM REMOTE MIKE w/CLIP | 45 |
| MNM-6095 HT90/440 SPEAKER MIKE | 45 |
| MNM-6064 HEADSET—DUAL MUFF w/BOOM | 75 |
| MNM-6065 HEADSET—DUAL MUFF w/MASK | 75 |
| TMN-6045 MICOR MOBILE MIKE | 35 |
| TMN-6057 MICOR HANDSET | 30 |
| TMN-6104 MAXAR MIKE (wire in style) | 40 |
| TMN-6149 MAXAR 80 MIKE w/PLUG | 40 |

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| 9 T81JJA MITREK 110W* #L4A | \$ 675 |
| 2 T51JJA MITREK 060W* #L4A | 475 |
| 2 B71RTB MICRO BASE 110W* L4 DC/TC | 1750 |
| 9 T71RTN MICOR 110W* 4F L4 MOBILE | 625 |
| 2N-1132 MOTRAC BASE 350W PAGING 43.58 | 795 |
| 1 C71LHB MOTRAC BASE 100W* B-U/DC | 695 |
| 5 T71BBA MOCOM 70 100W* L4 MOBILE | 695 |
| 2 T51BBA MOCOM 70 60W* L4 MOBILE | 395 |

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| MSTR Pro Series | |
| VM76RAS33 330 W BASE 42-50mhz | 995 |
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| VT85VAS88 90W UHF PRO REPEATER | 575 |
| CT45AAU88 CUSTOM MVP MOBILE UHF 35W | 325 |
| CT45AAU92 CUSTOM MVP MOBILE 800 mhz | 225 |

MISCELLANEOUS EQUIPMENT

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| TLE-8813 MOCOM 70 UHF MOTHERBOARD | NEW! 75 |
| TLE-6583 MOCOM 70 UHF PRE-SELECTOR | NEW! 35 |
| TLN-5720 MOCOM 70 8F OSC DECK | 45 |
| T-1376BM TONE CONTROL BASE CONSOLE | 125 |
| T-1600 OPTION BOARDS/KITS | 25 |

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| NLN-6778/equiv HT/MT OMNI LONG w/T-strap | \$ 22 |
| NLN-8861 MX SERIES PLASTIC BELT HOLDER | 9 |

POWER SUPPLIES

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| HPN-1001 MITREK P/S 120/240 13.6-15A | \$ 75 |
| HPN-1002 MITREK P/S 120/240 13.6-15A | 75 |
| TPN-1084 MOCOM 70 BASE SUPPLY 13.6-15A | 75 |
| TPN-1136 MAXAR/PS 120VAC/13.6VDC-7.5A | 75 |
| TPN-1154 MAXAR/PS 120VAC/13.6VDC-12.A | 75 |

MOBILE ACCESSORIES

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| HLN-4010 MITREK CONTROL HEAD 1F | \$ 39 |
| HLN-4011 MITREK CONTROL HEAD 4F | 45 |
| TCN-1091 MICOR CONTROL HEAD 1F | 35 |
| TCN-1092 MICOR CONTROL HEAD 4F | 40 |
| HLN-1004 SYNTOR CONTROL HEAD 1F | 45 |
| HLN-1005 SYNTOR CONTROL HEAD 4F | 55 |
| TKN-6718 PULSAR II IMTS | |
| CONTROL CABLE | NEW! 75 |
| TKN-8009 PULSAR P100 IMTS CONTROL CABLE | 45 |
| TKN-8976 PULSAR II/CELLULAR DUAL CABLE | 125 |
| TKN-6455 equiv MICOR CONTROL CABLE 4F | NEW! 55 |
| HKN-4030 SUNTOR 4F CONTROL CABLE | 75 |
| TSN-6016 MICOR MOBILE SPEAKER w/BRKT | 22 |
| TLN-4445 MOTRAC—MOCOM MIKE H-U | 14 |
| TLN-5181 MICOR MIKE HANG-UP BOX | 14 |
| TLN-5404 MICOR HAND-SET HANG-UP | 10 |

PRIVATE LINE BOARDS PL/DPL

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| TRN-6177 MAXAR PL ENCODER/DECODER | \$ 65 |
| TRN-6207 MAXAR DPL ENCODER/DECODER | 45 |
| TLN-4294 MICOR PL DECODER | 50 |
| TLN-4928 MICOR PL ENCODER (WIDE PIN) | 25 |
| TLN-5726 MICOR DPL ENCODER | 25 |
| TLN-5731 MICOR PL ENCODER (NARROW PIN) | 20 |
| TLN-5817 MOCOM 70 DPL ENCODER/DECODER | 95 |

MISCELLANEOUS ITEMS

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| TLN-43909 MICOR POSITIVE GROUND CONVERTER | 45 |
| TLN-6252 MOBILE NOISE REDUCTION KIT | 25 |
| TLN-5992 MAXAR LOCKING BRACKETS | NEW! 25 |

PULSAR I & II CARDS

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| TLD-1824 P1 XMIT VCO | \$ 25 |
| TLD-8951 P1 PRE DRV | 25 |
| TLN-1582 P1 A/2 IF | 25 |
| TLN-5241 P1 XMIT LOGIC | 25 |
| TLN-5246 P1 AUDIO BRD | 25 |
| TLN-5242 P1 RX LOGIC | 25 |
| TLN-5249 P1 MJ INTFZ | 25 |
| TLN-5250 P1 FACS INTFZ | 100 |
| TLN-5251 P1 MK INTFZ | 10 |
| TLN-5254 P1 SPRVSR | 25 |
| TLN-5386 P1 SPRVSR | 25 |
| TLN-5668 P1 FACS INTFZ | 25 |
| TLN-5828 BUSY CALL BRD | 25 |
| TRN-4525 PII REF LOGIC | 25 |
| TRN-4903 PII M A C S | 100 |
| TRN-5125 PII DETECTOR | 25 |
| TRN-5170 PII INTFZ | 100 |
| TRN-5171 PII INTFZ | 100 |
| TRN-5278 PII INTFZ | 100 |
| TRN-6499 PII RX LOGIC | 25 |
| TRN-6500 PII RX LOGIC | 25 |
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| TRN-6504 PII SPRVSR | 25 |
| TRN-6505 PII SPRVSR | 25 |
| TRN-6511 PII 12/14 INTFZ | 25 |
| TRN-6512 PII 12/14 INTFZ | 25 |
| TRN-6706 PII INTFZ PII CH | 100 |
| TRN-6708 PII INTFZ | 100 |
| TRN-6709 PII INTFZ PII CH | 100 |
| TRN-6764 PII INTFZ | 100 |
| TRN-6967 INTFZ MK7 | 10 |
| TRN-8024 P1 TX LOGIC | 25 |
| TRN-8192 P1 SPRVSR | 25 |
| TRN-8291 PII RX LOGIC | 25 |
| TRN-8292 PII REF LOGIC | 25 |
| TRN-8293 REF LOGIC | 25 |
| TRN-8289 PII IF BRD | 25 |
| TRN-8366 PII INTFZ | 25 |
| TRN-8641 PII REF LOGIC | 25 |
| TRN-8642 PII INTFZ PII CH | 25 |

SYSTEM 90 CARDS

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| HLN-4527 MITREK 1F ALTERNATE CONTROL | \$ 49 |
| TLN-4519 CHANNEL SCAN 4F PRIORITY | 49 |
| TLN-4520 CHANNEL SCAN 4F NON PRIORITY | 49 |
| TLN-4521 QUICK CALL II 2-TONE DECODER | 25 |
| TLN-4522 QUICK CALL II-UNIT & GROUP | 25 |
| TLN-4524 MICOR 12 WATT EXTERNAL PA | 25 |
| TLN-4525 SINGLE TONE ENCODER 1 TONE | 25 |
| TLN-4526 SINGLE TONE ENCODER 5 TONE | 30 |
| TLN-4527 MULTI PL ENCODER 4 TONE | 25 |
| TLN-4528 MULTI PL ENCODER 8 TONE | 30 |
| TLN-4529 MICOR F1 ALTERNATE CONTROL | 45 |
| TLN-4530 MICOR 4F ALTERNATE CONTROL | 55 |
| TLN-1695 DTMF ENCODER (2 BOARDS) | 19 |
| TLN-5154 MULTI DPL ENCODER 4 TONE | 49 |
| TLN-5155 MULTI DPL ENCODER 8 TONE | 49 |
| TLN-5735 MITREK MULTI DPL | |
| ENCODER 8 CODE | 49 |
| TRN-6015 DTMF MOBILE DECODER | 49 |
| QLN-6661 PULSE DECODER(SP) | 25 |

BASE STATION CONTROL CARDS

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| TLN-4038 F1 CONTROL | 25 |
| TLN-4042 GUARD TONE DECODER | 25 |
| TLN-4048 C2 R2 CONTROL | 25 |
| TLN-4050 SQUELCH CONTROL | 25 |
| TLN-4050 REPEATER CONTROL | 25 |
| TLN-4054 WILD CARD | 35 |
| TLN-4637 PAGING DC TRANSFER | 30 |
| TLN-4638 F1 PL CONTROL | 35 |
| TLN-4658 F1 CONTROL | 35 |
| TLN-4661 DC TRANSFER | 30 |
| TLN-4662 SQUELCH GATE | 45 |
| TLN-4668 LINE DRIVER (2 OUTPUTS) | 49 |
| TLN-4670 LINE DRIVER (SINGLE OUTPUT) | 39 |
| TLN-4685 STATION CONTROL | 35 |
| TLN-4836 TIME OUT TIMER | 35 |
| TLN-4852 GUARD TONE DECODER | 35 |
| TLN-4907 EMERGENCY POWER TRANSF | 10 |
| TLN-5132 R1 MUTE | 25 |



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*Harvey Research Organization, Rochester, NY

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5 MITREK, 154 MHz, T53JJA3900

5 MOTRAC, 154 MHz, T73MHT3130

1 MICOR Base, 31 MHz, B91RCB1196

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14 MOCOM 70, 33 MHz, T51BBN3000

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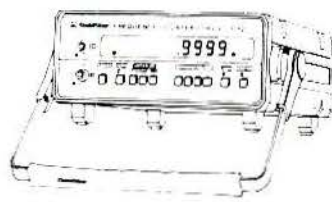
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| 800 MHZ | | 150-174 MHZ cont. | | MOTOROLA PORTABLE RADIO CHARGERS cont. | |
|---|-------------|---|------------|--|------------|
| | UNIT PRICE | | UNIT PRICE | | UNIT PRICE |
| Mot "SyntorX", 35w, trunked (T45VBJ5G00) mobile | 550 | GE "Mastr Pro", 100w, 1F, c/sq (MT76TAS) | 100 | As above, 6-unit, rapid (NLN7177) | 295 |
| Mot "SyntorX", 35w, trunked (T45VBJ5G00) mobile | 550 | | | HT90/HT440, 1-unit rapid (NLN7646) | 60 |
| Mot "Mostar", 35w, trunked (D45TLA5G00) mobile | 500 | | | As above, 1-unit, 16 hr (NLN7645) | 35 |
| Mot "Mostar", 15w, trunked (D35TLA5G00) mobile | 450 | | | As above, 1-unit, 16 hr pocket (NLN7493) | 12 |
| Mot "Traxar", 15w, trunked (D35TLA5G00) mobile | 400 | | | MT500/HT220, 1-unit, rapid, omni (NLN4569/6897) | 75* |
| Mot "Motrac", 10w, trunked (D25WLA5G00) mobile | 250 | | | As above, 1-unit, 16 hr, omni (NLN4561/6804) | 40 |
| Mot "SyntorX", 10w, trunked (L35VBB5174) base | 500 | | | As above, 12-unit, 16 hr, slim (NLN4558) | 150 |
| Mot "Mostar/Traxar", trunked no heat sink/P.A. parts radio | 75 | | | *Available for 220vac operation | call |
| Mot "STX/MTX", 800 trunked portable as available | call | | | Radius P100, 1-unit, 16 hr, pocket (NTN4881) | 10 |
| Mot "Micor", 35w, 5-channel trunked (T45RTA5G00) | 300 | | | | |
| Mot "MX350T", 15w, 5-channel trunked portable w/DTMF | 250 | | | | |
| Mot "Micor", 35w conventional PL/DPL | 350 | | | | |
| Mot "Maxar 80", 10w conventional PL/DPL | 250 | | | | |
| Mot "MX320", 15w conventional, DPL, 2F (H25AAU) | 350 | | | | |
| Mot "Flexar", 10w conventional, DPL, (L35TRK) | 325 | | | | |
| GE "Corona" Marc V trunked, 15w | 275 | | | | |
| STD C666L conventional, 35w, no mic | 175 | | | | |
| 450 MHZ | | 30-36 MHZ | | MOTOROLA PORTABLE RADIO SPEAKER MICS | |
| | UNIT PRICE | | UNIT PRICE | | UNIT PRICE |
| Mot "MitreX", 100w, PL/DPL (T74JJB) | 500 | Mot "Micor", 100w, 1F, c/sq (T71RTN) | 350 | MTX800, MTX1000, HT600 (NMN6172) new/used | 45/40 |
| Mot "MitreX", 50w base (L54JJB) local/tone rem., PL/DPL | 750 | Mot "Mocrom 70", 100w, 1F, PL (U518BN) | 150 | SABER (NMN6128) | 60 |
| Mot "Micor", 75w, PL (T54RTA), 2F, talk around | 375 | GE "Mastr II", 100w, 1F, CG (MC74AAU) | 400 | As above, public safety (NMN6129) | 75 |
| Mot "Mocrom 70", 75/50/25w, PL (T48BA) w/accy | 250/200/150 | GE "Exec II", 50w, 1F, CG (ST74AAW) | 300 | STX, straight, coiled, public safety (NMN6115/4339/6050) | 60 |
| Mot "Mocrom 30w", PL/DPL (D44TLA) 1/8F | 250/300 | RCA "Tac200", 100w, 1F, QC (MBA19WB11) | 150 | EXPO (NMN6100) | 40 |
| Mot "Maxar 50", 20w, DPL (D34JAA) 2F | Special 200 | AER "M-Pac", 100w, 1F, c/sq (70RR1) | 150 | HT90/HT440 | 50 |
| Mot "Maxar", "Maxar 80", "Maxar 50" also available | call | | | MT500 coiled/straight (NMN6082/6081) | 60 |
| Mot Industrial Dispatcher, motorcycle radio, 8w PL, w/accy (D34DCN) | 75 | | | HT220, remote/universal (NMN6049/6042) | 25 |
| Mot "Micor", 75w repeater, 1-user, PL/DPL, duplex | 2500 | | | NOTE: EXPO, HT600, HT90 mics needing repair are available | 15 |
| Mot "Motrac", 250w base, PCP on 462.925 MHz, PL, tone rem. 1995 | 1995 | | | | |
| GE "Mastr II", 100w, 2F, CG (MC75CCU) | 400 | | | | |
| GE "Mastr Pro", 70w, 1F, CG (MT75TAL) | 100 | | | | |
| GE "Mastr II", 25w, 12F, CG (EC45PPU) | 300 | | | | |
| GE "Mastr II", 40w, 4F, c/sq (MX55KES) | 300 | | | | |
| GE "Mastr II", 40w, 8F, CG (X55KJU) w/w/s rcvr | 350 | | | | |
| 150-174 MHZ | | BASE STATION ACCESSORIES | | ACCESSORY ITEMS | |
| | UNIT PRICE | | UNIT PRICE | | UNIT PRICE |
| Mot "Mocrom 70", 100w, 2F, PL (T73BBA) | 400 | Mot deskset, local control 1F/PL (T1370) new/used | 90/65 | Mot MAXAR, MOTAR, ac power supply (TPN1136/HPN1007) | 95 |
| Mot "Mocrom 70", 45w, 4F, PL (T43BBA) | 250 | Mot controller, local, series 90, 1F/PL (T1903C) new/used | 135/100 | Mot MSTAR desk mic, c/sq/trunked (HMN1005) 20 ea., 3 for 50 | 300 |
| Mot "Motrac", 100w, 4F, PL (U73MH1) | 160 | Mot controller, tone remote, series 90, 1/2F, PL/OCII (T1926) new | 275 | Mot MICOR base station power supply (TPN1096) | 300 |
| Mot "Motrac", 100w, 1F, c/sq (U73MH1) w/o accy | 50 | Mot controller, DC remote, console, 2F, c/sq (T1601) | 300 | Mot MT500 Converta-Comm w/12w audio accy's (N1244) | 175 |
| Mot "Maxar 50", 25w, 1/2F, PL (D33JAA) | 200/225 | Mot controller, tone remote console, PL (T1605) | 300 | Mot MX series Converta-Comm w/12w audio accy's (N1248) | 175 |
| Mot "Maxar 50", 10w, 2F, c/sq (D23JAA) | 150 | Mot controller, DC/tone remote console, 2F/4F/8F (T1617) | 1000-1200 | Mot positive ground kit Micor or Motrac | 40 |
| GE "Mastr II", 100w, 4F, CG (MX78KFU) | 400 | Mot phone patch, automatic "Mart" (L1159) 2 prom | 350 | Mot time out timer kit, Micor or Motrac | 15 |
| | | Mot duplexer, 450 MHz, 4-cavity bandpass (T1507) | 325 | Mot base station mics, c/sq or PL, Mocrom 70, Maxar | 35/40 |
| | | Mot OCII paging encoder, 6/36/100/900 call (E08ENC series) | 50-400 | Mot MSTAR type hang up box, new (HLN4655) | 5 |
| | | | | Mot Micor system 90 DTMF encoder (TLN5837/TTN6006) clearance | 20 |
| | | | | Mot Micor system 90 DTMF decoder (TRN6015) clearance | 20 |
| | | | | GE "Mastr Pro" base station power supply (EP38 series) | 300 |
| | | | | GE "Mastr Pro" transmitter/receiver strips | call |
| | | | | GE PE, 1-unit, rapid charger, int. safe (38L1AIX) | 60 |
| | | | | GE Mastr II cable kit, 2/8F | 40 |
| | | | | GE Mastr II control head 1/4F | 35/40 |
| | | | | RCA TAC200, 1F cable, new box of 8 | 50 |
| | | | | RCA TAC100, 450 MHz, 4w portabl w/o batt, as is | 15 |
| | | | | RCA 700/1000 cables or control heads | 15 |
| | | | | RCA TAC100 1-unit rapid charger | 50 |



AIR COMM

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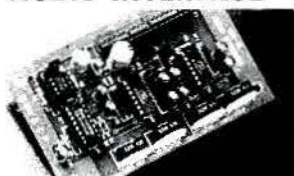
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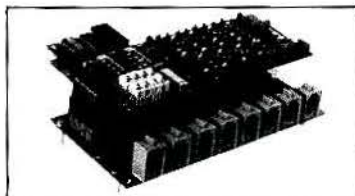
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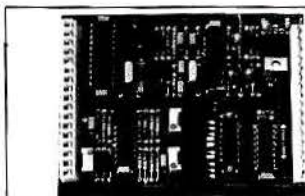
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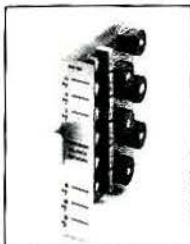
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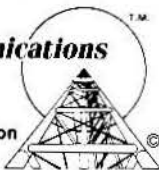
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A d index/hotline

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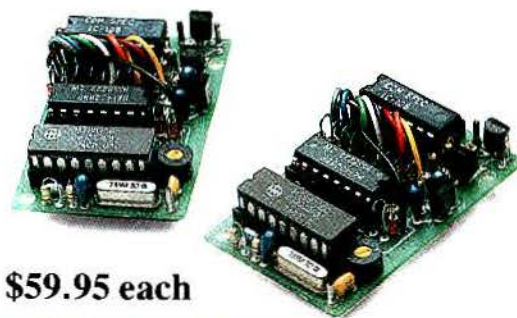
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